J. Hortl. Sci.
Vol. 12(2) : 180-185, 2017

Original Research Paper

Evaluation of commercial dipping oil for production of quality raisins from Thompson Seedless grapes

Ajay Kumar Sharma*, Sharmistha Naik, S.D. Sawant, Pratiksha Kadam and R.G. Somkuwar
ICAR-National Research Centre for Grapes,
Manjari Farm, Solapur Road, Pune-412307 (India)
*E-mail : Ajay.Sharma1@icar.gov.in

ABSTRACT

Grape growing in India is mainly confined to tropical peninsular regions of Maharashtra, Karnataka and Tamil Nadu. It is estimated that approximately 95% of total grapes are produced in Maharashtra and Karnataka alone. About 71 per cent of total grape production of the country is consumed as fresh and 27 per cent is processed into raisins. Grape drying is mainly concentrated in Sangli, Solapur and Nashik districts of Maharashtra and Vijayapura and Bagalkot districts of Karnataka. Generally, after dipping of grape bunches in solution of ethyl oleate and potassium carbonate (also known as Australian dip) the grape bunches are spread on nylon mesh inside grape drying shed and within 10-15 days drying process completed. There are several commercial products/substitutes for dip treatment available in the market. However, it has been reported that effectiveness of these products is variable. Therefore, present investigation was carried out to study effectiveness of a new commercial product for raisin production from Thompson Seedless grape variety in comparison to ethyl oleate. Grape bunches of Thompson Seedless were dipped in these solutions prior to drying inside raisin drying shed. Besides, the drying bunches were also sprayed with different concentrations of these products on 3rd and 5th days of drying. Observations were recorded on drying dynamics, browning index, colour intensity, content of phenols and tannins, sensory properties and quality parameters after storage for 4 months. It was observed that the dip treatment of Thompson Seedless grapes with a solution of 18 ml commercial product and 24 g potassium carbonate per litre of water for 2 minutes and sprays of 12 ml commercial product +16 g potassium carbonate per liter water on 3rd day and 6 ml commercial product + 8 g potassium carbonate per liter water on 5th day was found better than ethyl oleate for production of good quality raisins.

Key words: Ethyl Oleate, drying dynamics, quality, raisins

INTRODUCTION

Grape production in India is mainly concentrated in Maharashtra and Karnataka and contributing about 95% of total grape production of country. Grapes are mainly utilized for fresh consumption (~ 71%) and followed by raisin making where about 27% of total production is utilized (Sharma, 2017). The raisins are being made in Sangli, Solapur and Nasik districts of Maharashtra and Vijayapura and Bagalkot districts in Karnataka due to prevalence of suitable climatic conditions. Thompson Seedless is one of the predominant commercialtable grape cultivar, which also has better attributes for processing into raisins (Jogaiah et al., 2014). Raisin production is greatly influenced by total soluble solids (TSS) at harvest, rate of drying and different drying conditions such as temperature, humidity, and exposure of drying grapes to direct sunlight (Somkuwar et al., 2013). Beside it pretreatments of grape bunches or application of solutions during drying also play an important role not only in improving quality of dried grapes, but has significant impact on number of days required for drying.

Dipping of grape bunches in solution of ethyl oleate (1.5%) and potassium carbonate (2.5%) for 2-4 minutes is a common practice followed for raisin making, after which,the drying process is completed within 10-15 days (Adsule et al., 2012). Although, ethyl oleate is extensively used in dip treatment, there are several products available in the market containing this compound or its substitute. Efficacies of many of these products have not been worked out. Therefore, attempts were made to develop better products. Giridhar et al. (2000) reported that the drying rates for grapes treated with mixed fatty acid esters were higher than the commercial dipping oil - ethyl oleate. In addition to the standard chemicals which are recommended for dip treatment of grapes, some other commercial products are also available in Indian market and are being used by raisin producers. However, no scientific data have been generated on its effect on drying kinetics and quality of raisins. Akshay Dip Super manufactured by M/s West Coast Herbochem Ltd containing 95.7% ethyl oleate, 1.4% antioxidant preservative and rest emulsifier, is one such commercial product. The present investigation was, therefore, carried out to compare drying kinetics and quality of raisins produced using ethyl oleate and Akshay Dip Super.

Table 1. Details of dip and spray treatments

Treatments	Dipping Schedule (Quantity in 1 liter water) At beginning of the experiment	Spray Schedule (Quantity in 1 liter water)	
		1st Spray (3rd day)	2nd Spray (5th day)
T1 (Control)	Ethyl Oleate (15 ml) + Potassium Carbonate (25 g)	Ethyl Oleate (15 ml) + Potassium Carbonate (25 g)	Ethyl Oleate (15 ml) + Potassium Carbonate (25 g)
T2	Akshay Dip Super (18 ml) + Potassium Carbonate (24 g)	Akshay Dip Super (12 ml) + Potassium Carbonate (16 g)	Akshay Dip Super (6 ml) + Potassium Carbonate (8 g)
T3	Akshay Dip Super (15 ml) + Potassium Carbonate (25 g)	Akshay Dip Super (15 ml) + Potassium Carbonate (25 g)	Akshay Dip Super (15 ml) + Potassium Carbonate (25 g))
T4	Akshay Dip Super (21 ml) + Potassium Carbonate (24 g)	Akshay Dip Super (14 ml) + Potassium Carbonate (16 g)	Akshay Dip Super (7 ml) + Potassium Carbonate (8 g)

MATERIAL AND METHODS

The experiment was conducted in the grape drying shed of ICAR-National Research Centre for Grapes (ICAR-NRCG), Pune during February-March, 2016. Details of experimental treatments are given in **Table-1.**

Grape bunches having healthy berries were harvested at >23°Brix TSS. The dip and spray solutions were prepared by mixing appropriate quantities of ethyl oleate, Akshay Dip Super and potassium carbonate as given in **Table 1**. After the harvest, grape bunches were dipped in prepared solutions for a duration of 2 minutes. After dipping, treated bunches were spread on nylon mesh inside the grape drying shed. Additional sprays of the chemicals were given on 3rd and 5th day of drying as per schedule given in **Table 1**.

During the grape drying process, samples were collected on daily basis. The moisture contents (in percentage) in the samples were measured using Moisture Analyzer of LCGC (Model Axis). Number of days required for achieving 15% moisture content was considered as required duration for raisin making. Total Phenolic Content (TPC) was determined with F-C reagent according to the method of Slinkard and Singleton (1977) using UV-vis-Spectrophotometer and gallic acid as standard phenolic compound. Tannins were determined by Folin-Denis method given by Schanderl (1970) using UV-Vis-spectrophotometer and tannic acid as a standard. Browning index and colour intensity in collected samples were measured by using UV-Vis-spectrophotometer. The raisins from all treatments were collected when the moisture level was reached at 15% and stored in sealed polythene bags at low temperature (4-5 ^{0}C) in refrigerator for a period of 4 months. After 4 month's storage, these samples were again analyzed for different quality parameters. Each treatment was replicated four times and data were analyzed as per CRD.

For organoleptic testing, a sensory panel was constituted comprising of 10 persons (5 males and 5 females) having basic training on organoleptic studies of raisins and experience of raisin tasting. The sensory attributes were colour, texture, sweetness, flavor, mouthfeel, taste and overall acceptability. Raisins from all treatments were evaluated based on 9-point Hedonic scale (9-like extremely, 8-like very much, 7-like moderate, 6-like slightly, 5-neither like nor dislike, 4-dislike slightly, 3-dislike moderately, 2-dislike very much, 1-dislike extremely). However, in case of rancidity more values were mentioned for more rancidity and it was noted on a scale of five. The scores obtained from panelists were used for determining mean values. Three samples were analyzed from each treatment.

RESULTS AND DISCUSSION

Effect on dynamics of moisture loss/drying period

Effect of different treatments on period required for drying is presented in **Table 2**. Significant differences were noted in different treatments for % moisture content during entire drying period. It is evident from the data that the grapes in treatment T2 lost moisture rapidly and dried much faster **(Fig. 1).** This trend of rapid moisture loss in treatment T2 was consistent over entire drying period. The rate of moisture loss was very rapid in this treatment up to 7th day after which it plateaued till 15th day **(Table 2)**.

Table 2. Dynamics of moisture loss in different treatments

Treatments	Moisture content (%) on days of drying														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
T1	70.84	58.84	42.63	34.89	29.87	26.75	23.21	22.22	21.93	21.93	19.72	18.81	17.80	16.94	15.84
T2	66.51	58.38	34.24	32.39	31.05	29.79	20.71	20.70	19.89	19.89	18.32	17.04	16.47	15.77	14.30
T3	68.40	59.19	48.52	34.013	32.82	31.79	24.02	23.07	19.70	19.70	18.96	18.05	17.03	15.20	16.32
T4	68.73	62.80	44.25	32.98	33.143	28.813	20.803	19.89	19.22	19.22	19.58	18.00	17.08	16.43	15.30
C.D. (5%)	2.248	1.345	2.798	NS	NS	1.719	1.699	NS	1.213	1.086	0.88	NS	NS	0.851	1.022

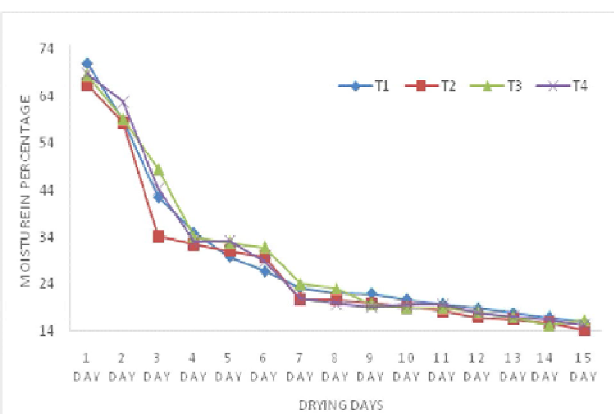

Fig. 1. Dynamics of moisture loss during grape drying

Effect on physical appearance and biochemical constituents of raisins

The data presented in **Table 3** indicate that the biochemical constituents and physical appearance of raisins were significantly affected by different treatments. Lowest colour intensity (0.787) was noted in T3 followed by T2 (0.787), while maximum colour intensity (0.908) was recorded in T1. In case of browning index, the differences were non-significant with minimum browning (0.571) in T2 followed by T-3 (0.597). Phenols and tannins are also colour contributing compounds and interaction of phenols with polyphenol oxidase (PPO) is mainly responsible for

Table 3. Effect on of raisins in different treatments

Treatments	Colour Intensity	Browning Index	Phenols (mg/g)	Tannins (mg/g)
T1	0.908	0.609	0.68	0.77
T2	0.787	0.571	0.92	1.00
T3	0.773	0.597	0.95	1.02
T4	0.893	0.616	0.80	0.89
C.D(*P*=0.05)	0.043	NS	0.047	0.060

browning in raisins. Maximum total phenol content (TPC) was recorded in T3 (0.920 mg/g), followed by T2 (0.92 mg/g) while the minimum TPC (0.68 mg/g) was observed in T1. Similar trend was noted in case of tannin content in raisins. Maximum tannins were recorded in T3 and T2, and minimum in T1(0.77 mg/g).

Effect on sensory properties of raisins

Data presented in **Table 4** indicated that maximum score in colour, texture, sweetness, flavor, mouthfeel, taste and overall acceptability was registered in T2.

Table 4. Sensory evaluation of raisins prepared in different treatments

Parameters	Treatments and Hedonic scale score			
	T1	T2	T3	T4
Colour	6.67	7.33	6.33	6.33
Texture	6.44	7.28	5.94	6.22
Sweetness	7.00	7.89	5.61	6.50
Flavor	5.56	7.50	5.22	6.44
Mouth feel	6.67	7.17	5.22	6.56
Taste	6.83	7.67	5.17	6.72
Overall acceptability	6.72	7.67	5.39	6.56

The values of T2 were followed by T1 and T4 in all parameters except flavor. The raisins produced in T3 treatment recorded lowest values for most of the sensory parameters **(Fig. 2).**

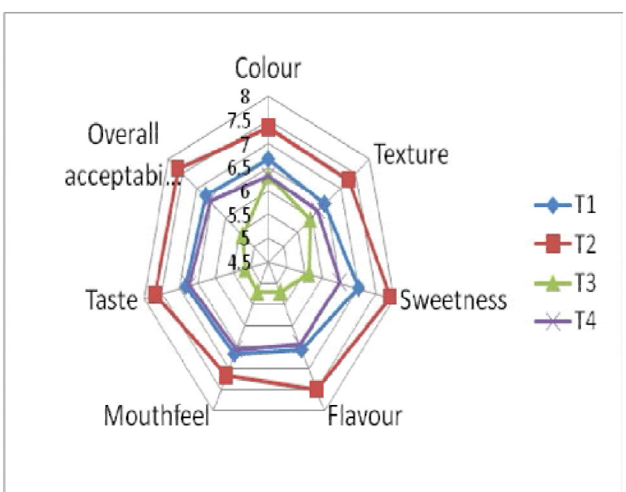

Fig. 2.Overall acceptability of raisins produced by different treatments.

It has been demonstrated that the type of chemical pretreatment and origin of the product used in pretreatment significantly affects the drying behavior of the grapes (Christensen and Peacock, 2000). In general, the aim of pretreatment is to increase drying rates and to produce raisins of desired qualities (Doymaz and Pala, 2002). The dynamics of changes in moisture content, colour intensity as well as contents of phenols, flavonols, flavonoids and flava-3-ols in the raisins were also significantly affected by the pretreatments (Sharma et al., 2013). These quality variations due to pretreatments and also impacts of origin of emulsions were evident in the present studies. The treatment T-2 with Akshay Dip Super exhibited superiority over the ethyl oleate for all quality parameters evaluated. The probable reason for above superiority of this product over ethyl oleate maybe due to the availability of 1.4% antioxidant preservative. Sharma et al (2016) reported that ascorbic acid acts as an antioxidant that helps in maintaining colour of raisins and its application reduces drying period.

Effects on raisin quality parameters after 4 month's storage

Color is a main qualitative feature of dried fruits and it changes during storage due to some chemical and biochemical reactions. Low temperature storage is recommended for raisins. Storage temperature is one of the important factors for change in raisin color after storage and it has been reported that storage at higher temperatures enhance browning (Simal et al.,1996). Quality parameters of raisins after 4 month's storage at 4-5 ^{0}C are depicted in **Table 5**. It can be seen from this data that the moisture content was surprisingly increased in all treatments. Minimum browning index (0.957) and colour intensity (1.353) is again recorded in T-2. Maximum TPC was noted in T-2 (0.503 mg/g),while, raisins of T-3 showed maximum tannin content (0.709 mg/g). Reduced TPC and tannin contents were observed in raisins after storage than before storage.

Effect on sensory parameters of raisins stored for 4month at 4-5 $^{\circ}$C

The results on sensory evaluation of stored raisin are presented in **Table 6**. Maximum score for colour, texture, sweetness, flavor, mouthfeel, taste and overall acceptability was again registered in T2. Treatment T1 had scored lowest score in all observed sensory

Table 5. Effect of 4 month's storage on moisture (%), colour intensity, browning, phenol content and tannin content of raisins in different treatments.

Treatment	Moisture (%)	Colour intensity	Browning index	TPC (mg/g)	Tannins (mg/g)
T1	17.943	1.683	1.293	0.432	0.518
T2	16.617	1.353	0.957	0.503	0.665
T3	16.530	1.577	1.140	0.496	0.709
T4	16.043	1.763	1.260	0.478	0.639
CD ***(P= 0.05)***	0.947	0.084	0.046	N/A	0.116

parameters. Thus, the results revealed that the application of Akshay Dip Super is superior for retaining sensory qualities of raisins stored for a period of 4 months at 4-5 °C. The data related to rancidity revealed that the raisins from T2 were found with lesser rancidity

Table 6. Organoleptic scores of raisins store at low temperature for 4 months

Parameters	T1	T2	T3	T4
Colour	6.46	7.61	7.30	7.46
Texture	6.61	7.46	7.23	7.30
Sweetness	7.00	7.92	7.92	8.15
Flavour	6.61	7.46	7.30	7.46
Mouthfeel	6.46	7.53	7.00	7.46
Taste	6.53	7.30	6.92	7.30
Overall Acceptability	6.69	7.38	7.23	7.38
Rancidity	3.38	2.00	3.00	2.23

Storage temperature is an important factor for quality changes in stored raisins. With the increase in storage temperature, browning increases and the color of raisin becomes undesirable.Bahaadad and Esmaiili (2012) determined that raisins stored at 4-11°C have the lowest color change in comparison to other samples stored at higher temperatures. During the storage, sugars dissolves incrementally in water and then diffuse to the fruit surface and crystalize. It requires some time for equilibrium of crystal layer so that water distribution is delayed. The color change is the major consequence of seeking the equilibrium. Aksoy (1992) reported that the water sorption-desorption between the raisins, the storage atmosphere, and the sugars deposited on the fruit surface is established in a more complex manner than with most foods. In the present study, colour intensity and browning index were increased during storage but it was lower in T-2 than other treatments. Important sensory problems also occur during the storage of raisins due to enzymatic and non-enzymatic browning reactions, the kinetics of both these reactions are dependent on water activity (Aguilera et al. 1987). In case of sensory parameters, T-2 is again found superior over other treatments. On the basis of data collected in present study during 2015-16, it is observed that the dip treatment of Thompson Seedless grapes with solution of Akshay Dip Super (18 ml) and potassium carbonate (24 g) per liter of water for 2 minutes followed bytwo sprays on 3rd day [Akshay Dip Super (12 ml) + Potassium Carbonate (16 g)/litre] and 5th day [Akshay Dip Super (6 ml) + Potassium Carbonate (8 g)/liter] are found superior for production of quality raisins.

ACKNOWLEDGEMENT

The authors are thankful to M/S West Coast Herbochem Ltd, Mumbai for financial assistance to the study. The authors would also like to show their gratitude to theDirector, ICAR-NRC for Grapes, Pune and panelists of organoleptic studies for their support on collecting valuable data.

REFERENCES

Adsule P.G., Sharma A.K.; Banerjee, K. and Karibasappa, G.S. 2012. Raisin industry in India: adoption of good drying practices for safe raisins. *Bull. OIV*, **85(974-975-976)**:209–216.

Aguilera, J.M., Oppermann, K. and Sanchez, F.1987. Kinetics of browning of sultana grapes. *J.food.Sci*, **52(4)**: 990-993, 1025.

Aksoy, M.S. 1992. Effects of storage conditions on the quality of seeded raisins during long-term storage. MS thesis, Middle EastTechnical University, Turkey.

Bahaadad, G.A. and Esmaiili, M. 2012. Effects of different dipping solutions and storage conditions on the color properties of raisin. *American-Eurasian J. Agric. & Environ. Sci.*, **12 (10)**: 1311-1315. DOI: 10.5829/ idosi.aejaes.2012.12.10.65188.

Christensen, L.P. and Peacock, W.L. 2000. Raisin Drying Process. *Raisin Production Manual*,Christensen, L.P. (Eds.). UC DANR Pub.*California*, pp. 207-16.

Doymaz, I. and Pala, M. 2002. The effects of dipping pre-treatments on air-drying rates of the seedless grapes. *J. Fd. Engg*. **52**: 413-17.

Giridhar, N., Satyanarayana, A., Balaswamy, K. and Rao, D. G. 2000. Effect of mixed fatty acid esters prepared from different vegetable oils on the drying rate of 'Thompson seedless' grapes. *Journal of Food Science and Technology* **37 (5):** 472-476.

Jogaiah, S., Sharma, A.K. and Adsule, P.G. 2014. Rootstock influence on the biochemical composition and polyphenol oxidase activity of 'Thompson Seedless' grapes and raisins. *Int. J. Fruit Sci*. **14**:133–146. doi: 10.1080/ 15538362.2013.817767.

Schanderl, S.H. 1970. Methods in food Analysis.AcademicPress.NewYork. p709.

Sharma, A. K. 2017. Raisin making in India: Technological interventions for better quality. https://www.researchgate.net/publication/ 319953925. DOI:10.13140/RG.2.2.32619. 03363/1

Sharma, A.K., Rajguru, Y.R., Adsule, P.G. and Goswami, A.K. 2013. Pretreatments of Tas-A-Ganesh grape bunches and subsequent effect on grape drying. *Ind. J. Hortic*.,**70(1)**:107–111.

Sharma, A.K., Banerjee,K.,Ramteke, S.D, Jogaiah, S., Somkuwar, R.G. and Adsule,P. G. 2016. Evaluation of Ascorbic acid and sodium metabisulphite applications for improvement in raisin qulaity. *Proc. Natl. Acad. Sci., India, Sect. B Biol.Sci.,***86(3)**: 637-641. DOI10.1007/ s40011-015-0499-8.

Simal, S., Rossello, C., Sanchez, E. and Canellas, J. 1996. Quality of raisins treated and stored under different conditions. *J. Agri.Food.Chem*.,**44 (10)**: 3297-3302.

Slinkard, K. and Singleton, V.L. 1977. Total phenol analyses: Automation and comparisons with manual methods. *Amer. J. Enol. Vitic*.**28**: 49-55.

Somkuwar, R.G., Bondage, D.D.,Surange, M.,Navale, S. and Sharma, A.K. 2013. Yield, raisin recovery and biochemical characters of fresh and dried grapes (raisin) of Thompson Seedless grapes (*Vitis vinifera*) as influenced by different rootstocks. *Ind.J.Agri. Sci*.,**83**: 924-927.

(*MS Received 07 November 2017, Revised 10 December 2017, Accepted 16 December 2017)*