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Study on raisin quality and storability affected by coating of guar gum and glycerol combinations

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Abstract
Raisin is an important agriculture product which turns sticky and hard due to syrup exudation and loss of water during storage. Surface coating provides protective layer to the product and it is found to reduce losses and extended life. Present study was carried out at ICAR-National Research Centre of Grapes, Pune during 2018. Manjari Kishmish raisins having 15 per cent moisture were utilized to study influence of guar gum coating on quality and storage. Different combinations of guar gum with glycerol were applied for 2 minutes on raisins and compared with control. The coated raisins were stored at 25±2 °C for a period of 40 days. Physiological loss in weight (PLW), antioxidant activities (DPPH assay) and colour intensity were noted at interval of 10 days. Minimum PLW (1.13%) was recorded in T3 followed by T2 on 40th day of storage. T3 was registered with better antioxidant activities (38.12%). Minimum color intensity (0.14%) was also observed in T3 on 40th day of storage. Poor condition of raisins were recorded in control. On the basis of data collected during study it is concluded that coating of raisins with 0.25% guar gum with 40 per cent glycerol extended storage life and maintained good colour with higher antioxidant activities.

Keywords: Manjari Kishmish, dried grapes, storage, colour intensity, quality

Introduction

Grape is the significant fruit consumed by human beings since ancient times. Basically it is fruit originated from temperate region but well adapted under tropical conditions of India. Maharashtra and Karnataka states are contributing about 95% of total grape production of the country (Sharma *et al.*, 2017) [18]. Grape drying is a very old practice of grape processing and India is using 27 per cent of total grape produce into raisins. Drying of grape bunches under shade is a common practice followed in major raisin making areas of Maharashtra and Karnataka. Concentrated sugars, low moisture and lower pH of raisins make it a shelf stable food. No deterioration in raisin quality is observed when stored at low temperate. Due to exudation of syrup and moisture loss raisins become hard and sticky during storage. Sometimes raisins become brown and lose good appeal and economic value. Surface coating can be solution of these problems by providing proper covering to raisins surface (Ghasemzadeh *et al.*, 2008) [4]. An edible coating has shown to be a preservation technique which preserves fruit plumpness, fresh appearance and hardness as well as gives the shiny surface to fruits, therefore increases the commercial value of fruits (Xu *et al.*, 2003) [21]. Traditionally, food corporations use polymeric films (polyethylene PE, plastic PP, poly-styrene PS) to pack fruits and vegetables owing to their massive availability at a relatively low price and their good mechanical properties, a barrier to oxygen, carbon dioxide (Siracusa *et al.*, 2008) [17]. But the major use of synthetic packaging films has resulted to serious ecological issues due to their total non-biodegradability. Thus, biodegradability is not solely a functional demand however, conjointly a very important environmental attribute. Renewable raw materials like starch and bio-derived monomers can be used as bio-based packaging fruits and vegetables by replacing petrochemical-based materials with biodegradable is increasing day by day (Tharanathan, 2003) [20]. Preparation of edible film is carried out by using hydrocolloids, proteins, polysaccharides, lipids and composites (Donhowe *et al.*, 1993) [2] and coatings applied by dipping, spraying, brushing and panning followed by drying. The polysaccharide, guar gum which is galactomannan rich flour, water soluble obtained from the leguminous Indian cluster bean (*Cyamopsis t etragonoloba* L.). Linear chain of D-mannopyranose units connected to each other by β-1,4-bonds linked to galactose residues by 1,6- bonds forming short side-branches is the backbone of this hydrocolloid (Roberts *et al.*, 2011; Moser *et al.*, 2013; Heyman *et al.*, 2014) [14, 10, 7]. Being a versatile material guar gum acts as thickener in many food applications due to its significant physico-chemical characteristics and is highly available at low cost and is biodegradable in nature.

Guar gum coating is found effective in improving the shelf life of the tomatoes (Ruelas *et al.*, 2017 and Ghosh *et al.*, 2014) [15, 5]. Ghasemzadeh *et al.*, (2008) [4] evaluated the effect of pectin coating on raisins. They found that the Thompson Seedless raisins coated with pectin resulted in best colour and texture while in the term of flavour, samples covered with gum proved to be the best. Considering the value of raisins, losses during storages and benefits of guar gum coating present study was carried out to optimize suitable coating for guar gum to obtain better quality raisins during storage.

2. Materials and Methods

Present research work was carried out at ICAR-National Research Centre of Grapes, Pune. Raisins of Manjri Kishmish grape variety were utilized in the study. Raisins of uniform size, shape, and color with 15% moisture content and having no sign of mechanical damage or fungal deterioration were selected for the present study.

The materials for coatings were prepared by adding different concentrations of guar gum and glycerol in distilled water and stirred for 30 min. The details of treatments are as described in Table 1. In each treatment, 100 g raisins were treated for 120 seconds and each treatment was replicated 5 times. Subsequently, raisins were air-dried. After completion of coating process, coated raisins were packed in polyethylene punnets with holes (100 g raisins/punnet) and stored at 25 °C ± 0.5 °C for 40 days. The samples were collected on 10^{th}, 20^{th}, 30^{th} and 40^{th} day of storage for observations on PLW while initial data (0 day) of DPPH assay and colour intensity was also noted.

Table 1: Details on coating treatments

Treatment	Composition
T1	0.25 per cent guar gum + 20 per cent glycerol
T2	0.25 per cent guar gum + 30 per cent glycerol
T3	0.25 per cent guar gum + 40 per cent glycerol
T4	0.5 per cent guar gum + 20 per cent glycerol
T5	0.5 per cent guar gum + 30 per cent glycerol
T6	0.5 per cent guar gum + 40 per cent glycerol
T7	1 per cent guar gum + 20 per cent glycerol
T8	1 per cent guar gum + 30 per cent glycerol
T9	1 per cent guar gum + 40 per cent glycerol
T10	Control

Observations were recorded on physiological loss in weight (PLW), per cent inhibition rate (DPPH assay) and color intensity. The weight loss was determined by gravimetric analysis, using Equation (1) (Restrepo *et al.*, 2010) [13].

$$\%PP = \frac{(P_i - P_f)}{P_i} \times 100 \qquad (1)$$

In which *%PP* is the percentage of weight loss and P_i and P_f are the initial and final weight of the sample (g), respectively.

To evaluate the evolution of the antioxidant activity of the raisins treatments during storage, the method of 2,2-diphenyl-1-picrylhydrazyl (DPPH during 30 min of reaction) was adopted. The method analyze the ability to trap radicals after treatment with coatings applied to raisins. For the preparation of raisins extracts, samples of 2.5 mg in 10 mL of methanol were homogenized. The homogenate was placed in an ultrasonic bath for 30 min at 4°C and centrifuged. The supernatant was filtered on Whatman paper No. 1. With the obtained extract, the samples were prepared, in which 5, 10, 20, 40, and 70 µL of the solution were taken and mixed with absolute methanol until 1 mL was completed (Keydis *et al.*, 2018) [8].

Color Intensity (CI) was determined by using the spectrophotometric absorbance of the extract at 420, 520,620 nm (Glories, 1984), using the equation 2.

$$CI = (Abs\ 420 + Abs\ 520 + Abs\ 620) * 2.5 \qquad (2)$$

The complete randomized design and the LSD method (least significant difference) for mean separation, with a confidence level of 95% ($\alpha = 0.05$), were used to evaluate the effect of coatings. The SAAS software was used for statistical analysis.

Results and Discussions

Raisins are hygroscopic in nature and absorb water if available in environment. If temperature is higher and then the product loss the water during storage. Applied coating crated a barrier between raisins and raisins. Data presented in Table 2 cleared the picture perfectly. Progress in storage of raisins was resulted in more PLW in each treatment. Lowest physiological loss in weight (1.13%) was found in T3 (0.25% GG+0.4g glycerol) followed by T2 (0.5%GG+0.2g Glycerol) which was (1.15%) on 40^{th} day of the storage. Whereas maximum physiological loss in weight (7.95%) was found in T10 (control). Among the coating treatments, T4 was registered with maximum PLW on 40^{th} day of storage. Baldwin *et al*., (1999) noted that guar gum coating reduces the physiological weight loss in fruits. Also, Garcia *et al.*, (1998) [3] revealed that the glycerol reduced weight losses and maintained texture and surface color of strawberry fruits. So, the coating has proved its capacity as barriers in present study and PLW is found lesser in coated raisins than control where no coating was applied.

Table 2: Effect of different coating combinations on PLW (%) during storage

Treatments	Storage Days			
	10	20	30	40
T1	0.15 ± 0.11^{dc}	0.75 ± 0.23^{c}	1.07 ± 0.70^{c}	1.16 ± 0.22^{e}
T2	0.18 ± 0.06^{dc}	0.59 ± 0.12^{ca}	0.82 ± 0.34^{c}	1.15 ± 0.51^{e}
T3	0.14 ± 0.04^{dc}	0.54 ± 0.18^{dc}	0.96 ± 0.29^{c}	1.13 ± 0.77^{e}
T4	0.38 ± 2.69^{b}	3.11 ± 1.49^{bd}	7.15 ± 3.84^{bac}	7.74 ± 3.65^{bdac}
T5	1.89 ± 2.15^{bdac}	4.06 ± 2.34^{dc}	4.14 ± 2.25^{bc}	5.76 ± 1.66^{ebdac}
T6	0.40 ± 2.79^{b}	4.12 ± 2.87^{bac}	5.33 ± 1.48^{bac}	5.74 ± 1.08^{ebdac}
T7	1.39 ± 3.45^{bdac}	4.67 ± 3.32^{bdc}	4.80 ± 4.61^{bc}	5.49 ± 4.05^{ebac}
T8	1.28 ± 1.79^{bdac}	2.87 ± 2.56^{dc}	3.88 ± 2.47^{bc}	5.76 ± 1.84^{ebdc}
T9	0.48 ± 3.20^{bdac}	$3.17\pm2.95c^{ba}$	5.28 ± 3.91^{bc}	5.84 ± 3.25^{ebdac}
T10	2.38 ± 0.22^{bdc}	4.43 ± 1.24^{bc}	5.54 ± 1.34^{bc}	7.95 ± 1.90^{ebdac}
LSD at 5%	3.15	2.97	5.66	6.55

Table 3: Effect of different coating combinations on Inhibition % (DPPH assay)

Treatments	Storage Days				
	0	10	20	30	40
T1	28.02±0.00^mnl	28.04±0.13^gf	33.96±0.12^e	34.20±0.06^c	35.81±0.07^i
T2	18.31±0.07^gef	22.60±0.07^h	31.11±0.24^e	31.46±0.07^f	33.81±0.12^h
T3	18.12±0.07^gef	21.00±0.07^cebd	25.24±0.35^r	29.41±0.12^i	38.12±0.13^b
T4	14.19±0.5^1ighkfj	18.43±0.07^cbd	27.11±0.30^v	28.60±0.64^u	30.85±0.00^s
T5	13.18±0.07^poq	22.59±0.06^cb	14.66±0.06^x	17.58±0.24^v	32.56±0.06^r
T6	12.40±5.05^proq	13.42±0.31^proq	21.05±0.07^y	24.47±0.68^x	25.48±0.36^i
T7	19.67±7.57^ba	20.48±0.18^gefd	24.82±0.00^x	28.21±0.00^h	32.11±0.06^o
T8	20.73±1.10^mnklj	22.74±0.00^r	25.71±0.07^l	30.50±0.57^p	35.40±0.27^j
T9	26.83±7.80^ghef	28.68±0.87^gefd	29.07±0.12^k	30.34±0.07^j	31.89±1.15^i
T10	25.75±8.21^pno	30.27±7.54^cefd	22.03±1.27^q	18.61±2.20^q	17.03±3.36^o
LSD at 5%	5.16	2.80	0.45	0.71	0.99

The data on inhibition are presented in Table 3. T3 is observed with maximum inhibition (38.12±0.13 %) which was closely followed by T1 with the value of 35.81±0.07 %. T10 (control) was recorded with minimum inhibition activity i.e.17.03±3.36% on 40th day of storage. Increasing inhibition rate during storage was found in all treatments except T10 when compared from 0 day. The similar results were noted by Loncaric *et al.*, (2016) [9] who has measured antioxidant activity of guar gum added samples by employing fundamental different methods: scavenging of the stable 2,2-azinobis(3-eth-ylbenzothiazoline-6-sulfonic acid) (ABTS) radical, 2,2- diphenyl-1-picrylhydrazyl (DPPH) radical and ferric reducing antioxidant power (FRAP) in quercetin model systems. They stated that samples with addition of guar gum had the highest antioxidant activity. Application of guar gum coating could be beneficial in prolonging the postharvest life, maintaining fruit quality and antioxidant content (ascorbic acid) of Indian olive fruits (Ghosh *et al*., 2017) [6].

Table 4: Effect of different coating combinations on color intensity (%) of raisins

Treatments	Storage Days				
	0	10	20	30	40
T1	0.35±0.01^j	0.33±0.00^u	0.33±0.02^lk	0.30±0.01^b	0.25±0.01^p
T2	0.39±0.01^i	0.31±0.00^lm	0.28±0.01^qpr	0.24±0.01^b	0.20±0.01^ml
T3	0.27±0.01^mno	0.24±0.01^pqor	0.19±0.01^n	0.17±0.01^b	0.14±0.01^p
T4	1.06±0.02^b	0.71±0.01^f	0.54±0.01^j	0.50±0.37^b	0.47±0.03^de
T5	0.81±0.02^g	0.74±0.03^d	0.72±0.04^e	0.68±0.38^b	0.60.07±0.05^f
T6	0.84±0.01^e	0.73±0.05^a	0.62±0.02^gfh	0.55±5.24^a	0.40.62±0.21^a
T7	0.68±0.01^qr	0.55±0.00^sr	0.42±0.02^d	0.39±0.01^b	0.29±0.00^opn
T8	0.37±0.00^sr	035.09±0.00^u	0.29±0.02^qpr	0.26±0.00^b	0.24±0.01m^oln
T9	0.47±0.00^sr	0.34±0.01^k	0.32±0.02^m	0.25±0.01^b	0.22±0.02^mln
T10	1.09±0.01^u	0.92±0.01^lk	0.81±0.01^p	0.73±0.02^b	0.67±0.01^ih
LSD at 5%	0.033	0.032	0.035	1.451	0.076

Browning of the raisins is undesirable in terms of the quality characteristics of the raisins. Hence low color intensity of the extracts were expected. Data presented in Table 4 clearly indicate that raisins from T3 having lowest color intensity (0.14±0.01) on the 40th day of storage and thus preventing browning of the product. While it was maximum in control where no coating was applied. The similar results were revealed by Demirci *et al.*, (2014) [1]. They observed that the meatball redness decreased with guar gum addition in raw and cooked meatball samples, which means that addition of gum resulted in a lighter-coloured product.

Conclusion

Guar gum coating in combination with glycerol as a coating material on raisins effectively reduced the physicochemical losses in raisins during storage of 40 days. The treatment combination of T3 (0.25% guar gum + 0.4g glycerol) given very encouraging results in the study. The application of guar gum with glycerol is capable to maintain raisin quality during storage at ambient conditions.

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