



The effect of putrescine and gum ghatti application on maintaining the quality of plum fruit cultivar "Golden Drop" during postharvest and cold storage period

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Abstract

The current study was conducted to elucidate the effect of gum ghatti (GG; 1% w/v), putrescine (Put; 100 µM), and a combination of both on maintaining postharvest quality of "Golden Drop" plum fruits during 40 days of storage at 1°C factorially (4×4) based on completely randomized design with three replicates. The results showed that Put and GG, alone or in combination, help protect plum fruit cell membranes during postharvest storage. Plum fruits coated with Put + GG showed significantly reduced weight loss, softening and electrolyte leakage, hydrogen peroxide and malondialdehyde production. During storage, TA decreased, associated to an increase in pH, and TSS increased. In conclusion, Put and GG coatings are recommended to maintain the quality of 'Golden Drop' plums during post-harvest cold storage.

Introduction

Plums can clearly show signs of chilling injury after prolonged cold storage at the optimal storage temperature of 0 to 1°C or when placed in the range of 3 to 8°C (Crisosto et al., 2004). Chilling injury in fruit leads to the accumulation of reactive oxygen radicals (ROS) to damaging levels (Palma et al., 2015), leading to lipid peroxidation and causing changes in membrane lipids and cellular wall structure (Mittler, 2002). Some gums such as gum ghatti (GG) have received little attention in food applications, including the formulation of edible coatings (Singh et al., 2024). Gum ghatti has higher viscosity than gum Arabic and does not crack when forming film, probably due to the effect of some polysaccharides acting as plasticizers (Joshi et al., 2017). Natural compounds such as polyamines are low molecular weight, open-chain hydrocarbon nitrogen compounds found in all living organisms [3], with putrescine (Put), spermidine (Spd), and spermine (Spm) being the major forms of polyamines identified in plants (Sharma et al., 2017). However, to our knowledge, there are not works in the literature that evaluate the combined effect of Put and GG on plums. Therefore, the objective of this work was to evaluate the effect of Put and GG, alone or in combination, on the quality characteristics of "Golden Drop" plums during cold storage.

Materials and methods

Plum fruits (*Prunus salicina* cv. Golden Drop) were harvested at commercial maturity (TSS = 16.1 °Brix; August, 2023) from a commercial orchard located in Sepidar Orchards area of Malayer city.

This experiment was conducted as a completely randomized 4×4 factorial design with three replicates, the first factor being the treatments and the second factor storage time. Treatments included: 1. control treatment (distilled water), 2. gum ghatti (GG; 1%, w/v), 3. Putrescine (Put; 100 µM), and, 4. Put + GG.

Plums were divided into 4 lots with 120 fruit per treatment. The fruits were immersed in each solution for 5 min and after drying at room temperature, they were packed in suitable plastic boxes and stored for zero (before storage), 10, 20 and 40 days after treatment at 1°C and 85% relative humidity, at these sampling days, weight loss, fruit firmness, total soluble solid (TSS), titratable acidity (TA), pH, electrolyte leakage (EL), malondialdehyde (MDA) and hydrogen peroxide (H₂O₂) were analyzed. Analysis of variance (ANOVA) was established by GLM procedures using SAS (9.4) and Duncan's multiple range test was used at a probability level of 1% for comparisons of means.

Results and discussion

weight loss and firmness were substantially higher in non-coated control fruits compared with the coated group. On day-40 of storage, physiological weight loss and firmness of Put + GG coated plum fruits were 56% and 34% lower as compared with control (Table 1). Moreover, plums treated with GG coating and Put, alone or in combination, showed lower TSS than control sample, indicating a delay in the ripening process of the plums (data not shown).

During storage, TA decreased, associated to an increase in pH, and TSS increased (data not shown). Although there were some significant differences between coated and control samples in pH and TA, at the end of the 40 days of cold storage, there were not significant differences among treated and control plums ($P > 0.01$). However, plums treated with GG coating and Put, alone or in combination, showed lower TSS than control sample, indicating a delay in the ripening process of the plums (data not shown).

The levels of EL, H₂O₂, and MDA increased in both treated and untreated samples as storage time increased. During storage, fruits treated with Put and GG exhibited lower EL, H₂O₂, and MDA than control samples. Thus, in the last days of storage (day 40), the fruits treated with Put and GG had 24%, 15%, and 19% less EL, H₂O₂, and MDA, respectively, than control plums (Table 1).

Table 1. Effect of putrescine (Put; 100 µM) and gum ghatti (GG; 1%), alone or in combination, on weight loss, firmness and electrolyte leakage (EL), malondialdehyde content (MDA), hydrogen peroxide (H₂O₂) of 'Golden Drop' plums during storage at 1 °C.

Treatments	Storage time (days)	Weight loss (%)	EL (%)	MDA (µm g ⁻¹ FW)	H ₂ O ₂ (µm g ⁻¹ FW)	Firmness (N)
Control	0	0.00±0.00 f	18.66±0.00 h	2.15±0.01 h	1.35±0.01 i	26.33 ± 0.67 a
GG		0.00±0.00 f	18.33±0.00 h	2.15±0.01 h	1.35±0.01 i	27.00 ± 0.58 a
Put		0.00±0.00 f	18.33±0.00 h	2.15±0.01 h	1.35±0.01 i	26.33 ± 0.33 a
GG + Put		0.00±0.00 f	19.00±0.00 h	2.15±0.01 h	1.35±0.01 i	27.66 ± 0.88 a
Control	10	3.20 ± 0.00 c	29.00±0.00 de	2.55±0.01 f	2.00±0.02 f	20.33 ± 0.33 c
GG		1.43 ± 0.28 e	26.66±0.00 g	2.60±0.06 f	1.85±0.00 g	24.00 ± 0.58 b
Put		1.73 ± 0.32 de	26.00±0.00f g	2.54±0.08 f	1.62±0.03 h	23.66 ± 0.33 b
GG + Put		1.33 ± 0.13 e	26.33±0.00 g	2.42±0.01 f	1.65±0.00 h	23.66 ± 0.33 b
Control	20	4.03 ± 0.37 b	40.66±0.00 d	3.15±0.02 d	2.50±0.03 b	14.00 ± 0.58 e
GG		2.26 ± 0.19 d	35.66±0.00 d	2.91±0.01 d	2.35±0.01 cd	19.33 ± 0.33 c
Put		1.73 ± 0.33 de	36.00±0.00 e	2.65±0.03 f	2.17±0.06 e	20.33 ± 0.33 c
GG + Put		1.96 ± 0.30 de	34.33±0.00 ef	2.54±0.01 d	2.01±0.00 f	20.66 ± 0.33 c
Control	40	5.53 ± 0.44 a	65.33±0.00 a	3.82±0.06 a	2.70±0.02 a	11.00±0.58 f
GG		2.43 ± 0.15 d	54.00±0.00 bc	3.49±0.05 b	2.55±0.01 b	15.66±0.33 d
Put		3.40 ± 0.21 bc	54.33±0.00 b	3.35±0.07 c	2.38±0.02 c	16.66±0.33 d
GG + Put		2.36 ± 0.09 d	50.00±0.00 c	3.11±0.04 d	2.30±0.01 d	16.66±0.33 d

Mean values followed by different letters indicate significant differences by Duncan's test ($P < 0.05$). Data are means ± SE.

According to our findings, the edible coating based on Put + GG used in this study delays fruit ripening and increases its shelf life.

References

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