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The effects of bagging on fresh fruit quality of *Canarium album*

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Abstract

The effects of bagging with different bags to the clusters on fresh fruit quality in Xiangtian olive of *Canarium album* were studied. The results indicated that, the color and smoothness were better, the edible pulp rate and ascorbic acid concentration were higher after bagging than in the control during the two years' experiments, but the fruit soluble solids were decreased. It showed that the golden yellow color, more smoothness, higher single fruit weight, more delicate flesh and better degree of slag for the fruits were obtained with Shengda double-layer bags especially. However, the bags need size specifications modified with few holes on the bottom.

Key words: Xiangtian olive, fruit bagging, fresh fruit quality, *Canarium album*.

Introduction

Chinese olive is from *Canarium* Raeusch. genus of Burseraceae. The different types of fruit are also called astringent fruit, green fruit, green Chinese olive, yellow Chinese olive and others, distributed widely in the Southeast Asian tropical and subtropical areas, and mainly produced in Guangdong and Fujian Provinces of China [1,2]. The fruit have special medical value and health effects such as quenching thirst, stimulating the appetite and helping digest, detoxicating, curing throat disease and halitosis [3]. The excellent cultivation varieties, especially the famous Three Ridge Olive, called Sanleng olive in this area, were the treasure for hospitality gift in the Spring Festival in Chaozhou area of Guangdong Province, showing 5 to 10 times or more value than the common varieties, often in short supply [4]. In conventional cultivation, it is difficult to control insects and diseases in Chinese olive production. Thus, there are problems, such as bad coloring, pollutant plaque, sunburn, sooty mold caused by aphis on the fresh fruit, with commercial and eating value reduced[4].

The fruit bagging technique is widely adopted in the production of apple, pear, grapefruit, litchi, longan and other fruits [5-8], for improving fruit quality and reducing pesticide residues effectively, preventing from rust, decreasing rates of insect or disease damaged fruit and cracking fruit. The effects of bagging were different from fruit trees. At present, there is scarce report on fruit bagging for Chinese olive. In the present study, the effects of different fruit bagging were studied for improving the fruit quality of Chinese olive.

Materials and Methods

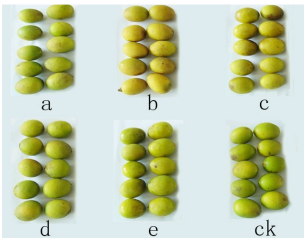
Profile of the experiment orchard: The experiment fruit orchard was located in Jiexi county of Jieyang municipal of Guangdong Province. The weather was characterized by south subtropical monsoon climate, with mild temperature of 21.1ºC in average, plentiful rainfall of 2105 mm annually, sufficient light and heat, moist and fertile soil.

Experiment materials: The tested cultivation variety was Xiangtian olive, an excellent cultivation selected from seedlings. The five kinds of bags with 320 mm×220 mm specifications, such as kraft paper bags, green plastic bags and white plastic bags and Shengda double layer paper bags, of which the inner layer was deep blue and the outer one yellowish were used in experiment. Shengda single layer paper bags, provided by Shengda Special Paper Co., Ltd., were tested in the middle hills in 2008. The three kinds of bags, such as Shengda double layer paper bags, Shengda single layer paper bags, and single layer sulfuric acid paper bags, were tested again in 2009.

Experimental treatments: The insecticides and antiseptic were spread in the whole orchard before tested, then nine to ten bearing branches were randomly selected from three trees with consistent growth potential and bagged in July after the 2nd physiological fruit drop. The fruit clusters with apex buds or young shoots were bagged and then shoots were sprouted out the bag in 2008 (Fig. 1), and the fruit clusters were bagged only in 2009 (Fig. 2). The tested fruit were picked together with bags in mid-November after

Bagging with white net bag

Bagging with green net bag



Bagging effects with 5 kinds bags, a: GPNB, b:SDLPB ,c:KPB, d: WPNB, e: SSLPB

Figure 1. The fruit bagging experiment of Xiangtian olive in 2008. (GPNB: Green plastic net bag; SDLPB: Shengda double layer paper bag; KPB: Kraft paper bag; WPNB: White plastic net bag; SSLPB: Shengda single layer paper bag).

Bagging effect with SDLPB

Bagging effect with SSLPB

Bagging effect with SLSAPB

Figure 2. The fruit bagging experiment of Xiangtian olive in 2009. (SDLPB: Shengda double layer paper bag; SSLPB: Shengda single layer paper bag; SLSAPB: Single layer sulfuric acid paper bag).

maturing, the breakage conditions of bags were inspected firstly, and the fruit characters were analyzed in laboratory.

The percent of breakage bag and fruit retention: The percent of breakage was calculated using equations as Br = 100×(the amount of breakage bag/ total tested bags), the percent of fruit retention was calculated using equations as Rf = 100×the amount of fruits after tested/ the amount of fruits before tested.

Determination of the fruit characteristics: Fruit characteristics consisted of outer characteristics and inner quality. The main outer characteristics included fruit color, single fruit weight, smooth degree, diameter and vertical length, fruit shape index, and others. The main inner quality included color of fruit pulp, flavor, slag degree, content of soluble solids and concentration of ascorbic acid and so on.

Determination of ascorbic acid: Vitamin C was determined by 2,6-dichlorindophenol titration [9]. In titration of standard solution, 2.0 ml standard ascorbic acid liquid was added correctly into 100 ml conical flask, 8 ml % oxalic acid added into the solution, titrated by sodium dichloroindophenol from the micro-burette until the solution turned into light red, and kept 15 s that meant that titration was finished, then 1 ml dye used can be calculated as proportional to the number of ascorbic acid. The tested fresh fruit was washed up and the water on the surface was blotted up with bibulous paper. Then, 10.0 g of the fruit pulp was taken from the fruit into the organization blending machine, with 50 ml 2% dicarboxyl added, and agitated into homogenate. The 18 g of this homogenate was infused into the 50 ml volumetric flask, diluted to the scale with 2% oxalic acid, left aside for 10 min, the filtrate was reserved next. Two shares of 10.0 ml filtrate were added and filled into 100 ml conical flask and titrated as the above method. The ml amount of dye titrated is V, the mg amount of ascorbic acid per ml dye T, the g amount of the sample in 10 ml liquid W, and the content of ascorbic acid was calculated as

$$V_C(\text{mg}\cdot 100\ \text{g}^{-1}\ \text{FW}) = \frac{V \times T}{w} \times 100 = \text{the amount of ascorbic acid in 100 g sample pulp.}$$

Data analysis: The relative data were analyzed with SAS 16.0 statistical analysis software.

Results

The quality and percent of fruit retention: In 2008, the highest percent of breakage was got with kraft paper bags, while the lower one with green plastic net bags and white plastic net bags. The highest percent of fruit retention was got with white plastic net bags. There were small differences both in the percent of breakage and in the percent of fruit retention in 2009, which might be related to the inappropriate method and the more strong wind in the mid-hills in 2008 (Table 1).

Table 1. The quality of tested bags and the percent of fruit retention.

yr	Treatment	No. of total bag	No. of breakage bag	Percent of breakage (%)	Percent of fruit retention (%)
2008	GPNB	27	12	44.44 a	87.86 b
	WPNB	27	15	55.55 b	97.62 c
	KPB	27	21	77.78 c	82.69 a
	SDLPB	27	12	44.44 a	81.72 a
	SSLPB	27	15	55.55 b	80.27 a
2009	SDLPB	30	7	23.30 a	86.35 b
	SSLPB	27	7	25.90 a	93.32 b
	SLSAPB	31	6	19.35 a	91.43 b

GPNB: Green plastic net bag;: Shengda double layer paper bag; KPB: Kraft paper bag; WPNB: White plastic net bag; SSLPB: Shengda single layer paper bag; SLSAPB: Single layer sulfuric acid paper bag.

The effects of bagging on fruits appearance: The fruits appearance of Xiangtian olive was improved by all treatments, and the most significant effect was got with SDLPB for even golden yellow, smoother, and higher fruit shape index (Table 2 and Figs 1 and 2). However, there was lower fruit weight with SSLPB and WPNB than in control in 2008, and the color of peel was even yellowish and smoother in all treated fruits, also the best color was got with SDLPB in the next year.

The effects of bagging on fruit internal quality: The edible pulp rate was increased with SDLPB and with KPB, soluble solid was decreased with WPNB and with KPB, the content of vitamin C was higher both with KPB and with WPNB and the condition of pulp slag was better with KPB, SDLPB and SSLPB treatment (Table 3). It can be seen comprehensively that the better fruit quality was got with SDLPB and KPB in 2008. The edible pulp rate and the content of vitamin C were increased, but the soluble solid was decreased by all treatments in the next year.

Discussion

The fruit peel color and smooth conditions were improved, the edible pulp rate and the content of vitamin C were increased with fruit bagging during two years' experiment, especially the very beautiful golden yellow color, and obvious less scab fruit was got with SDLPB treatment. However, there was a trend of decreasing the soluble solid content by all treatments, consistent with the results with double layer bag in apple [10]. It may be due to the light transmission rate, and then photosynthesis was more or less decreased with different kinds of bags [11]; fruit transpiration rate and the liquid flowing rate toward fruit were decreased, the input of assimilates to fruit was directly or indirectly reduced because of the high humidity in the micro-environment of bags. The photosynthetic rate of leaves would be reduced as the sink strength decreased, because of the lowering in both fruit carbohydrate metabolism and in the activity of enzymes [12].

It was observed that a few strings with different number of fruits were separated from one cluster, and a few shoots could sprout from the strong cluster. The autumn shoots were important mother shoots for second year' bearing, and the growth potential would directly affect the number of flowering and fruit in the next year. So, the whole clusters of fruit were bagged in one bag like other in fruit trees, such as grapefruit, the germination and growth of autumn shoots were both limited, and the bag was broken easily. Fruit on different clusters were bagged with different specification bags.

Although the SDLPB had the best comprehensive effect in all tested kinds of bags, there were mold fruit sometimes caused by the poorly ventilated, higher humid environment in this kind of bag, so the specification and holes in the bottom were improved suitable for special fruit bag of Chinese olive.

Table 2. The effects of bagging on the fruits appearance of Xiangtian olive.

yr	Treatment	Color of peel	Fruit Wt. (g)	Smoothness	Diameter (cm)	Vertical L.G. (cm)	Fruit shape index (V.L./D.)
2008	GPNB	Yellow-green	11.15 b	Coarser	2.44	3.38	1.39 a
	WPNB	Yellow-green	9.90 a	Coarser	2.32	3.22	1.39 a
	KPB	yellow	10.85 b	Coarser	2.38	3.32	1.39 a
	SDLPB	Golden yellow	11.08b	Smoother	2.39	3.51	1.47 b
	SSLPB	Green-yellow	9.83 a	Smoother	2.31	3.21	1.39 a
	CK	Yellow-green	11.06 b	Coarse	2.41	3.35	1.39 a
2009	SDLPB	yellow	10.72 a	Glossy	2.39	3.58	1.50 a
	SSLPB	yellowish	11.91 b	Glossy	2.46	3.78	1.54 a
	SLSAPB	yellowish	10.76 a	Glossy	2.32	3.57	1.54 a
	CK	Yellow-green	11.48 b	Smoother	2.38	3.62	1.52 a

Table 3. The effect of bagging on inner fruits quality of Xiangtian olive.

yr	Treatment	Edible pulp rate (%)	Soluble solids (%)	Content of V_C (mg/100g)	Flavor	Color of pulp	Condition of pulp slag
2008	GPNB	83.72 b	12.47a	11.50b	rich	cream	poor
	WPNB	83.04 b	10.92 b	13.84 a	rich	cream	poor
	KPB	84.97 a	11.35 b	14.37 a	rich	cream	better
	SDLPB	84.07 a	12.42a	10.95 b	richer	beige or cream	better
	SSLPB	83.18 b	11.89 a	12.36 b	rich	cream	better
	CK	83.05 b	12.20 a	11.41 b	rich	cream	poor
2009	GPNB	82.84 b	13.20 a	11.23 a	rich	beige	better
	WPNB	81.99 a	13.20 a	12.47 b	rich	beige	better
	KPB	82.17 a	13.20 a	11.00 a	rich	beige	better
	CK	81.40 a	14.20 b	10.47 a	rich	beige	better

Conclusions

The golden yellow color, more smoothness, higher single fruit weight, more delicate flesh and better degree of slag for the fruits of Xiangtian olive (*Canarium album)* were obtained with Shengda double-layer bags especially. However, the bags need size specifications modified with few holes on the bottom.

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