

# Effects of Stored Pollens from Wild *Actinidia eriantha* Vines on Some Fruit Quality Traits

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## Abstract

Our study was conducted to determine *In vitro* germination ability of pollens from 25 wild *Actinidia eriantha* genotypes after one year freeze storage, afterwards we examined fertilization ability of stored pollens of 8 genotypes selected according to *In vitro* test results from aforementioned 25 genotypes, and finally investigated effects of stored viable pollens from “MH67”, “MH55”, “MH48” and “MH45” genotypes on fruit quality characters of the female experimental plant “M3” as the main purpose. Non-pollinated “M3” kiwifruit plant was taken as control. We found that *In vitro* germination and fertilization ability of different stored pollen sources, and also fruit quality characters including dry matter, total sugar, titratable acid, vitamin C, total polyphenol, total flavonoid, chlorophyll (“a”, “b”, and total) and carotenoid contents except total soluble solid content were significantly different. MH67 and MH45 genotypes were evaluated as the most suitable pollenizers which can be recommended as new candidate cultivars because of long term storage ability and brought about desired fruit quality characters. They also will be investigated more at further breeding studies.

## Keywords

*Actinidia eriantha*, Stored Pollen, *In vitro* Germination, Fertilization, Fruit Quality Traits

## 1. Introduction

The nutritional intake enriched with fruits and vegetables is quite protective to reduce the incidence of some disease as cardiovascular disease, several common cancers, and other chronic diseases because fruits and vegetables contain plentiful nutrients including vitamin, trace minerals, dietary fiber and many other classes of biologically active compounds. Human dietary experiments have shown the role of fruits and vegetables in the regulation of some potential dis-

ease-preventive mechanisms [1]. For example, a study on USA man and woman health suggested that the diet of even relatively small amounts of flavonoid-rich foods may be beneficial for reducing risk of fatal cardiovascular disease [2]. From this point of view, one experiment indicated that it defines total phenolic compounds and individual primary metabolites of wild grown and cultivated berry fruits germplasms as one of most valuable food sources in the biochemical evaluation carrying weight for food and pharmaceutical industry and also breeders [3]. Therefore we examined a kind of berry fruit that is kiwifruit.

Kiwifruit is the edible berry of the woody vine *Actinidia*. *Actinidia* genus comprises abundantly different varieties and cultivars with various properties. *Actinidia* is native to China, especially has rich genetic diversity in natural expanding. Kiwifruit is a unique and miracle fruit. It has incontrovertible nutritional value and health benefit compared with lots of other fruits. Because, kiwifruit has pretty much vitamin (C, E and K) contents, folate, carotenoids, potassium, fiber, and phytochemicals. It was suggested that regular kiwifruit consumption may provide supplementary protection against to cardiovascular disease and cancer thanks to its impact on oxidative stress [4]. In the genus, *Actinidia eriantha* is the third biggest variety with desirable features that can be transferred into commercial kiwifruit species by artificial breeding [5]. Lots of wild *A. eriantha* fruits are small, usually weigh from 20 to 40 g, and too acidic for commercialization. But, the new *A. eriantha* cultivar “*Bidan*” was selected with commercial edible value in Korea in 2002 [6]. A new selection of *A. eriantha* has been identified with large edible fruits and named “White” by the Institute of Horticulture, Zhejiang Academy of Agricultural Sciences. The fruit of White has peelable skin covered in dense white hair, an unusual elongate shape, and much higher vitamin C content (568.9 - 1137.0 mg/100g) than most other kiwifruits [7].

There are lots of studies to reference in the scope of this research, some of researches related with fruits quality traits were mentioned in this study. For instance, importance of the vitamin C as a vital nutrient in the human diet was announced that its deficient causes scurvy illness which has fatal risk. In addition, vitamin C has preclusive effect against chronic diseases [8]. Such a research on kiwifruit cultivars “*Bidan*”, “*Haenam*”, “*Daeheung*” and “*Hayward*” showed that the variation was significant in the total polyphenol, vitamin C contents and the total antioxidant capacity among cultivars and the total bioactivity was biggest in the *Actinidia eriantha* cultivar “*Bidan*” [9]. In terms of potential beneficial health properties and great importance in fruit quality, chlorophyll and carotenoid pigments which contribute to the characteristic bright green color of its flesh were also investigated by researchers, and it was known that these pigments have a considerable influence on consumer acceptance [10]. Various studies about chlorophyll and other antioxidant properties of different kiwifruit varieties were conducted [11] and [12].

Besides health benefits of other species in the *Actinidia* genus and *Actinidia eriantha* due to their antioxidant capacity, it is necessary to consider their dry

matter content, soluble solid content (SSC), acidity and sugar contents which are also related to consumer gustation sense in the market preference.

Fruit with a high SSC at harvest has a satisfactory flavor and can be stored well [13]. The higher SSC makes fruit taste sweeter. Using dry matter (which is highly correlated with SSC) as a taste indicator supplies the major advantage that dry matter remains essentially constant from harvest time to eating time [14]. A study about consumer evaluation of “*Hayward*” kiwifruit at harvest showed that there is a direct connection between “*Hayward*” kiwifruit dry matter content at harvest and consumer preference for fruit eating ripeness, consumers prefer fruits with higher dry matter content [15]. The investigation on vitamin C content, total acidity, dry weight of New Zealand cultivars of kiwifruit were also gave remarkable results [16].

In the perspective of prior investigations emphasized importance of consumption fruits as one of fundamental part of nutrient sources that should get involved in the human diet, the studies on research and development of fruit quality will always attract researchers’ intensive attention. In this context, investigations on pollen sources are very precious to improve the fruit quality which includes bioactive compounds, phytochemicals, vitamin, flavor, physical traits and fruit set. As distinct from using fresh pollen sources to achieve fertilization, we especially preferred using stored pollen sources. In this research, we first of all randomly chosen 25 wild genotypes in *Actinidia eriantha* variety and tested their germination abilities after one year storage. Then, we examined fertilization abilities of 8 genotypes selected within 25 genotypes. Finally, effects of selected viable stored pollen sources on fruit quality traits were investigated. There are sort of researches related with parts of our study in literature. According to one research, pollen stored at low temperature had better germination ability, and researcher emphasized that pollen storage is beneficial for breeding studies, genetic conservation, artificial pollination and self-incompatibility. Because, it overcomes some barriers such as variation of flowering times, failure of germination on stigmas, pollen tube elongation problems against to crossing varieties. Pollen storage is most efficient technique to provide flexibility in experimental studies, and produce new and improved types [17]. Pollen germination after one year cold storage ( $-20^{\circ}\text{C}$ ) resulted in highest percentage (49.02%) [18]. In the experiment on rose species; it was proven that cryostored pollen maintained its fertilization ability and produced seeds [19]. The study on frozen pollen stored among one year demonstrated that pollen stored at low temperatures sustained its original viability and fertility capacity so it was said that pollen storage is a useful tool for breeders [20]. Another research on *Carica papaya* L. “*Washington*” pollen which was freeze-dried and stored at  $-20^{\circ}\text{C}$  for 14 months showed that artificial pollination using stored pollen produced fruit set [21]. There are also similar studies on different species such as [22] and [23]. Although the importance of pollen storage about fertilization and germination abilities has been mentioned and the related studies were conducted, it seems that the researches about effects of stored pollens on fruit quality characters are not common or has not yet in-

terested. However, there are many valuable studies related with impacts of fresh pollen sources on fruit traits. The investigation about the impacts of the male plant pollens from four different kiwifruit varieties on fruit quality of Xiangji seedless kiwifruit by the artificial pollination indicated that the contents of soluble solids, total sugar, total acid and vitamin C of fruits from diverse pollinated groups were different and their vitamin C content all was significantly higher than the fruits in control group [24]. Pollen source was found more effective on fruit quality of date palm cultivar “*Dhakk*” [25]. To pollinate Frinar plum, the effects of pollens from distinct pollinators were significantly different on soluble solids content, titratable acidity and some other fruit quality index among the fruits [26]. The effects of different pollen grain sources were found significant on total soluble solids percentage and titratable acidity percentage in the fruits of Samany date palm cultivar [27]. The study on pollination to *Guiwei* Litchi cultivar by 12 different male cultivars in order to investigate fruit quality showed that total soluble solid, sugar, acid, vitamin C and chlorophyll contents were significantly affected by different pollen sources [28]. An investigation to select best pollen source for fried fig cultivar indicated that total soluble solids, total flavonoids were affected significantly by the pollen sources [29].

In this study, we aimed to rediscover the importance of pollen storage. In this case, we combined three kind of investigation include measuring germination ability and fertilization capacity of stored pollens after one year freeze storage, and impacts of them on fruit quality traits which are dry matter, total soluble solid, total sugar, titratable acid, vitamin C, total polyphenol, total flavonoid, chlorophyll and carotenoid contents.

## 2. Materials and Methods

### Materials

We collected flower clusters from 25 different wild male genotypes in *Actinidia eriantha* variety grown in Magu mountain region, Fuzhou city, Jiangxi province in the early may at 2014 spring at the same time. Materials in the ice bags immediately were transported to the laboratory of Jiangxi Agriculture University located in Nanchang city. Anthers were removed from flowers, and stayed to dry at room conditions. Afterwards, pollens were extracted to paper bags and immediately stored at freezer ( $-20^{\circ}\text{C}$ ) for one year till next pollination season at 2015 may. After one year freeze storage, viability test was conducted *In vitro* germination process. 100 pollen grains were randomly chosen in four replications to calculate average germination percentage using Digimizer software. We selected just 8 genotypes for hand pollination, because we aimed to find the most vigor and the weakest genotypes within the gene pool including 25 randomly chosen wild genotypes, and aimed to determine their differences in germination and pollination processes. Three genotypes (MH58, MH66 and MH43) were randomly chosen from lifeless group, a genotype (MH26, MH67 and MH48) was randomly chosen from each of three lowest percentage groups (a, ab, abc groups in variance analysis). Chosen one genotype (MH45) showed the highest germi-

nation percentage in “f” group and one genotype (MH55) was randomly chosen from “def” group that belongs to last three groups (def, ef and f). Unfortunately, we loosed MH22 pollen that is only one genotype in group “ef”. We preferred to examine didn’t germinated pollens for pollination, because we wanted to justify the equality and accuracy of *In vitro* germination test results under laboratory conditions with field pollination results. The selected 8 genotypes were used for hand pollination to fertilize “M3” female cultivar from *Actinidia eriantha* variety grown in the Jiangxi province kiwifruit germplasm research garden located in Fengxing County, Nanchang city. In the hand pollination process, ten balloon stage flowers from experimental female plant M3 were randomly chosen for each male genotype except MH26 genotype because it had relatively less pollens. Hand pollination was conducted using hair brush to dust gently pollens on stigmas, and flowers were immediately covered with paper bags to obstacle any contamination. At the 20<sup>th</sup> day after pollination, the bear fruits were counted. Then, the fruits from M3 non-pollinated and M3 pollinated by 4 genotypes (MH45, MH48, MH55 and MH67) were gathered at harvest time in 2015 October. The fruits of M3 pollinated by MH26 didn’t gathered, because four fruits were not enough for all fruit quality analysis. For these analyses, fresh fruits were frozen with liquid nitrogen, milled and preserved in freezer (−20°C) till using.

#### **Determination of dry matter and soluble solid content**

Soluble solid content were determined with four replications for each pollinated material by drop fruit juice on hand refractometer. For determining dry matter content, four thick slices from fruits with three replications were dried under 45°C for three days and then dry matter contents were calculated according to following formula:

$$\text{Dry weight/fresh weight} \times 100 = \% \text{ dry weight}$$

#### **Determination of soluble sugar content**

In determination of soluble sugar content, standard glucose solution (100 µg·ml<sup>-1</sup>), anthrone, ethyl acetate (CH<sub>3</sub>COOH), sulfuric acid and distilled water were used as reagents. Anthrone plays role at emergence blue green color, its color is deep and shallow and displays positive correlation with high sugar content. Blue color in 620 nm wave has bigger absorbing value. This method has the advantage of not requiring decontamination and quick analysis. The following formula used to determine soluble sugar content:

$$\text{Soluble sugar content\%} = \text{sugar}(\mu\text{g}) \times \text{dilute factor} \times 100 / \text{sample mass} / 106$$

#### **Titrateable acid content determination**

This experiment was conducted according to reference of “fruit and vegetables post-harvest physiology, biochemistry experiment guide” (Cao Jiankang, Wei Bo, Zhao Yu Mei, China light industry press 2007). Acid-base titration is a method to determine titrateable acid content in plant material. 0.1 mol·L<sup>-1</sup> NaOH standard solution, potassium hydrogen phthalate, phenolphthalein were used as reagents.

#### **Determination of vitamin C (2,6-dichloride indophenol titration method)**

This experiment was conducted according to reference of “plant physiology experimental guide” (Gao Jun Feng, Higher education publishing 2006). Oxalic acid solution, 2, 6-indophenol chloride, NaHCO<sub>3</sub> was used as reagents.

#### Determination of chlorophyll

80% acetone (6 ml) was added into test tubes with 1 g sample and left at room temperature away from light for 24 h. Then, samples were centrifuged at 10,000 rpm for 10 min. Supernatants were put into the light path in the cuvette with 80% acetone. Wavelengths were 470 nm, 663 nm and 646 nm to determine optical density (OD). OD values are substituted into the formula. Lichtenthaler Arnon law was revised, presented at the 80% in acetone extract. Three types of pigment content of formulas were:

$$Ca(\text{mg}/100\text{ g}) = (12.21 \times A_{663} - 2.81 \times A_{646}) \times 6 \times 100 / 1 / 1000$$

$$Cb(\text{mg}/100\text{ g}) = (20.13 \times A_{646} - 5.03 \times A_{663}) \times 6 / 1 \times 100 / 1 / 1000$$

$$CT(\text{mg}/100\text{ g}) = Ca + Cb$$

$$\text{Carotenoid}(\text{mg}/100\text{ g}) = (1000 \times A_{470} - 3.27 \times Ca - 104 \times Cb) \times 6 \times 100 / 229 / 1 / 1000$$

#### Extraction of polyphenols in *Actinidia* and its measurement

Solvent extraction is the most commonly using method. It is the using of soluble polyphenols to solve in water, methanol, ethanol, ethyl acetate, acetone or other solvents. The extraction rate is relatively high, easy to purify, refine, integrated research. Ethanol, gallic acid, acetone (30%), Folin-Ciocalteu reagent and 20% Na<sub>2</sub>CO<sub>3</sub> were used as reagents. Measurement was done in 765 nm wavelength absorbance.

$$w = C * 10 * V * 10^{-3} * 100 / 0.1 / M$$

$w$ , Total polyphenol content mg/100 g;  $C$ , Gallic acid concentration mg·L<sup>-1</sup>,  $V$ , Total crude extract liquid ml;  $M$ , Sample volume g (expressed in values of Gallic acid equivalent).

#### Determination of total flavonoids content

Measurement was done in 510 nm wavelength absorbance. According to standard curve to calculate flavonoids content:

$$w = C * 25 * V1 * 100 / V2 / M / 1000$$

$w$ , total flavonoids content mg/100 g;  $C$ , Mass concentration of rutin ug·ml<sup>-1</sup>,  $V1$ , Total crude extract liquid ml,  $V2$ , Measuring time using sample volume;  $M$ , Sample volume g.

At literature, it was seem that such methods what we used were also conducted in several researches. For example, total phenolic compound of 13 citrus species were determined by the Folin-Ciocalteu method, the extract samples were mixed with Folin Ciocalteu reagent (5 ml, 1:10 diluted with distilled water) for 5 min and aqueous Na<sub>2</sub>CO<sub>3</sub> were then added. The mixture was allowed to stand for 15 min and the phenols were determined by colorimetry at 765 nm [30]. Polyphenols, flavonoids and total chlorophylls were extracted from lyophilized fruits. Polyphenol extraction was carried out by Folin-Ciocalteu method

with measurement at 750 nm using a spectrophotometer. Flavonoids extraction was carried out using 5% NaNO<sub>2</sub>, 10% AlCl<sub>3</sub>, H<sub>2</sub>O and 1 M NaOH with measurement at 510 nm, and total chlorophylls, chlorophylls a and b were extracted with 100% acetone and determined spectrophotometrically at the following absorbance (nm): 661.6, 644.8 and 470, respectively [31]. The total phenolic content and total flavonoid content of banana inflorescences were determined by the Folin-Ciocalteu colorimetric method at 765 nm and colorimetric method at 510 nm using a spectrophotometer [32].

#### Statistical analysis

SPSS version 20 statistic software program was used. MANOVA analyzing method was conducted, and Tukey test ( $p \leq 0.05$ ) was performed.

### 3. Results and Discussion

#### *In vitro* pollen germination

*In vitro* pollen germination percentages of 25 wild male genotypes in *Actinidia eriantha* were different after one year freeze ( $-20^{\circ}\text{C}$ ) storage. According to one way variance analysis Tukey test grouping, the genotypes discriminated into 6 groups (“a” to “f”) (Table 1). Eight genotypes (MH10, MH30, MH31, MH34, MH43, MH57, MH58 and MH66) did not germinate. Five genotypes (MH26, MH60, MH46, MH48 and MH67) showed lowest germination percentages in first three groups (abc, ab, a), respectively. Six genotypes (MH45, MH22, MH71, MH56, MH70 and MH55) were placed in last three groups (def, ef, and f) with high percentages. The genotype MH45 had the highest pollen germination percentage after one year freeze storage with 61.25% value. In accordance with these results, we decided to choose 8 genotypes (MH55, MH45, MH48, MH67, MH26, MH58, MH66 and MH43) to use in hand pollination. In the material section, it was explained how we decided to choose these 8 genotypes.

#### Hand pollination

The pollens of selected eight genotypes were used to pollinate female plant M3. The pollination results showed that the flowers pollinated with MH58, MH66 and MH43 genotypes, which didn't germinate *In vitro*, did not bear any fruits. The pollination with MH26 that had the lowest germination percentage resulted with good fruit set. The genotypes MH67 and MH48 had full and almost full fruit set respectively, although their germination percentages were low. This result indicated that 12.25% (MH48) germination percentage is enough for fruit set over the average. On the other hand, the flowers pollinated with pollens of MH45, which had highest germination percentage, gave fruits less than MH67 and MH48. MH55 showed good fruit set with high germination percentage (Table 2). These different results may be due to several reasons such as genetic match, differences in biological vigor of stored pollens of differ genotypes against to diverse biotic factors.

#### Effects of stored pollen sources on fruit quality characters

Stored pollen sources from wild genotypes significantly affected fruit quality characters except total soluble solid content. Dry matter content ranged between

**Table 1.** Comparison of mean pollen germination percentages (%/°C) of 25 wild male genotypes in *A. eriantha* after one year storage.

Genotypes	Pollen Germination Percentage	
	N	Subset
No. 10	4	0.00a
No. 30	4	0.00a
No. 31	4	0.00a
No. 34	4	0.00a
No. 43	4	0.00a
No. 57	4	0.00a
No. 58	4	0.00a
No. 66	4	0.00a
No. 26	4	7.50a
No. 60	4	7.75ab
No. 46	4	10.25ab
No. 48	4	12.25ab
No. 67	4	18.25abc
No. 69	4	26.75abcd
No. 74	4	28.50bcde
No. 41	4	33.75bcde
No. 72	4	43.25cdef
No. 61	4	44.00cdef
No. 47	4	45.25cdef
No. 55	4	46.75def
No. 70	4	47.75def
No. 56	4	49.75def
No. 71	4	51.50def
No. 22	4	55.50ef
No. 45	4	61.25f

**Table 2.** Fruit set after artificial pollination.

Genotypes	%	Bear Fruit	Total Pollination	%
MH55	46.75	8	10	80
MH67	18.25	10	10	100
MH48	12.25	8	10	80
MH45	61.25	6	10	60
MH26	7.5	4	5	80
MH58	0	0	10	0
MH66	0	0	10	0
MH43	0	0	10	0

12.99% - 18.33%, soluble sugar content ranged between 5.95% - 8.70%, acidity ranged between 1.45% - 1.86% percent that was less than some kiwifruits such as

generally known “Bruno” and “Hayward” cultivars [33], soluble solid content ranged insignificantly between 11.45% - 12.97% that was high than some loquat cultivars in Turkey [34] and high than lots of berry cultivars [35]. In terms of taste characters which are dry matter, soluble solid, soluble sugar and acid contents, control cultivar M3 had higher acidity and respectively high sugar content. The analysis results showed that the pollens of MH67 caused numerical high soluble solid content, significantly highest dry matter content (18.33%) that was numerically high than a new identified *Actinidia eriantha* cultivar “White” (17.9%) [7]. It also had significantly moderate sugar and acid contents. The pollens of M55 affected all fruit taste characters with decreasing values. The fruits pollinated by MH45 had high dry matter (17.16%) and highest sugar (8.70%) contents with low acidity (1.45%) rate. Genotype MH48 provided just respectively high sugar content (Table 3).

On the other hand, in this study total polyphenol content ranged between 2.43 - 3.53 mg GAE/1g fw that higher than studied 10 kiwifruit varieties [36], flavonoid content ranged between 0.26 - 0.56 Rutin eq./1g fw, vitamin C content ranged between 519 - 804 mg/100 g, chlorophyll and carotenoid contents ranged between 3.82 - 6.24 mg/1g and 0.95 - 2 mg/100g respectively (Table 3). Chlorophyll content in our study was high than “Hayward” (3.2 - 4.1 mg/100 g) [12]. To evaluate effects of stored pollen sources on vitamin C, polyphenol, flavonoid, chlorophyll and carotenoid contents of fruits, the test results displayed that fruits pollinated by the pollens of wild *Actinidia eriantha* genotype MH67 contained high values except polyphenol. Especially, fruits had high vitamin C content (804 mg/100g) that higher than *Actinidia eriantha* cultivar “White” (628.4 mg/100g) [7], some kiwifruits grown in Italy [33] and some jujube cultivars (225.1 to 387.9 mg 100 g) [37]. The fruits pollinated by MH55 had low values than control and other pollinated variables. Total chlorophyll and chlorophyll “b” contents were statistically same in the fruits pollinated by MH55, 45, 48 and fruits from control M3 plant. The fruits from M3 (control) had only relatively high values in vitamin C and polyphenol contents. The pollens of MH45 provided highest polyphenol and flavonoid contents (3.53 - 0.54 mg/g) respectively. Genotype MH48 affected vitamin C (726 g/100mg) and chlorophyll “b” (2.35 mg/g) contents well.

**Table 3.** Comparison of effects of stored pollen sources on fruit quality characters including Vitamin C (VC), total polyphenol (TPP), total flavonoid (TF), chlorophyll a (Ca), chlorophyll b (Cb), total chlorophyll (TC), carotenoid (C), dry matter (DM), soluble solid (TSS), soluble sugar (SS), titreable acid (TA).

Crossing	VC (mg/100 g)	TPP (mg/g)	TF (mg/g)	Ca (mg/g)	Cb (mg/g)	TC (mg/g)	C (mg/100 g)	DM (%)	TSS (%)	SS (%)	TA (%)
Control	726c	3.1bc	0.35b	2.8a	1.5a	4.3a	1.36ab	16.8c	12.5a	8.2c	1.86c
M45*M3	676b	3.5c	0.54d	2.9a	1.8ab	4.7a	1.40b	17.2c	12.6a	8.7c	1.45a
M48*M3	726c	2.6ab	0.45c	2.2a	2.4b	4.6a	1.58bc	15.0b	11.9a	8.6c	1.62ab
M55*M3	519a	2.7ab	0.26a	2.2a	1.7ab	3.9a	0.95a	13.0a	11.4a	5.9a	1.50ab
M67*M3	804d	2.4a	0.56d	4.4b	1.9ab	6.3b	2.00c	18.3d	12.9a	7.0b	1.64b

We observed large variation in the fruit traits including dry matter, total sugar, titratable acid, vitamin C, total polyphenol, total flavonoid, chlorophyll and carotenoid contents except total soluble solid content due to impacts of stored pollen sources. Similar variations were also observed at different species and varieties pollinated using fresh pollens by several researches, Pollen source could significantly affect fruit quality features in the feijoa cultivar *Apollo* [38]. At commercial harvest stage, total sugar content varied in the range 9.6 - 14.4 g/100g fruit weight and the polyphenol content was strongly affected by the cultivar so that the highest polyphenol content was found in Hiratanenashi persimmon (916.8 mg GAE/100g fw) [39]. Ascorbic acid content, titratable acidity and percentage dry weight of seven pistillate cultivars of kiwifruit *Actinidia deliciosa* showed diversity [16]. Total soluble solid content and titratable acidity of some table figs (*Ficus carica*) showed diversity [40]. Polyphenols contents were 318.14 - 838.83 mg GAE per 100 g of dry fruit and the flavones were 367.64 - 1821.37 mg RE per 100 g of dry fruit in 15 kinds of red flesh crabapples [41].

The main aim of our study was investigate the effects of stored pollens on fruit quality properties and identify best pollen source. Consequently, the pollens from MH67 affected fruit characters quite well so that it ensured highest vitamin C content (804 mg/100g), carotenoid content (2 mg/100g), total chlorophyll content (6.24 mg/g), flavonoid content (0.56 mg/g), soluble solid content (12.97%), dry matter content (18.33%), and also had moderate acidity and sugar rates (1.64% - 6.98%). Genotype MH67 also showed best pollination match with full fruit set, although it had low *In vitro* germination percentage after one year storage. Genotype MH45 provided highest polyphenol content and sugar content (8.70%) with lowest acid (1.45%) rate. MH48 showed statistically similarity with M3 for some characters (vitamin C, polyphenol, chlorophyll, carotenoid, sugar and soluble solid contents). The pollens from MH55 genotype, that had high germination percentage with successful fruit set, negatively affected all fruit characters to compare with non-pollinated control genotype M3. To evaluate overall results, there was a distinct variation on fruit quality characters which were affected by different stored pollen sources. Genotype MH67 was the most suitable pollen source with better effect on fruit quality characters. On the other hand, the stored pollens from MH45 can also be made use of its efficiency with increasing sugar content and decreasing acid rate. Both of two, especially MH67, are good candidate wild genotypes to be selected as a new cultivar after future researches. We can say that wild genotypes will become very valuable germplasm sources for breeders all time with their natural adaptation features, genetic match, fertilization success, rich nutritional properties, health benefits, biochemical contents, especially long term preservation ability of pollens and so on.

#### 4. Conclusion

In this study, it was found that stored pollens affected fruit quality traits, thus we know that the pollens from valuable wild genotypes can be kept viable for long terms to obtain fertilization success with high quality fruit harvesting. Our study

will promote further studies to select best pollen source from rich wild *Actinidia eriantha* variety and *Actinidia* genus in China, and also this study is a supporting research to show maintainability of precious wild genotypes for evaluating in further research and breeding studies.

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