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Seedless Pumpkin Vegetable Production Using Gibberellic Acid (GA3) As Plant Hormone and Genetically Modified Technique

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Abstract

Pumpkin is one of the most important vegetables that meet the requirements of healthy nutrition. It is a tasty and valuable vegetable crop, containing a lot of biologically active substances and significant for dietary qualities. The study was carried out to investigate the seedless effect of GA3 150ppm on pumpkin by applying injection method and biochemical as well as nutritional quality. Current results showed that fruit weight was higher in the GA3 treated fruit than in control fruit. Moreover, Seed number and per seed weight were higher in the control than the GA3 treated pumpkin. However, 96.9% seedless pumpkin was found by the treatment of GA3 compared to the control. Biochemical content like glucose, inverted sugar and fructose content were found to be higher in the GA3 treated pumpkin than the control. In addition, potassium and calcium content were higher in the GA3 treated fruit than in control. Therefore present results showed that seedless pumpkin production can be possible by using GA3 150ppm.

Keywords: *Seedless, pumpkin, gibberellic acid, GM crop*

Introduction

The name ‘pumpkin‘ is commonly used for cucurbits of some species. In Central Europe countries pumpkins belonged to Cucurbita pepo L. (called also ‘squash‘), Cucurbita maxima Duch. (called ‘winter squash‘) and Cucurbita moschata Duch. ex Poir species are mostly grown. The quality of vegetables consists of some properties, which can be evaluated using physical and chemical methods (Abbott, 2001). One of the good quality traits of food is biological activity of a product, and especially its antioxidative activity. Antioxidants are compounds that protect cells against the damaging effects of reactive oxygen species. Some of antioxidant agents are found in vegetables. Products high in vitamin A, vitamin C, vitamin E, and beta-carotene content are believed to be the most beneficial. Carotenoids are red, orange or yellow fat-soluble plant pigments. These nutrients are commonly found in fruits and vegetables, those with the strongest colors being healthiest (Palace et al., 1999). In human carotenoids play important roles for antioxidant activity and some are also converted into the vitamin A. There are a lot of ß-carotene and a-carotene present in pumpkin. At present, there is no officially recommended dietary intake of carotenoids, but recommended dietary intake of vitamin A is about 1-3 mg per day of retinol equivalent (Murkovic et al., 2002). It is assumed that processing of vegetables improves the bio-availability of carotenoids, since it breaks down the cellulose structure of the plant cell (Van het Hoff et al., 2000). Experimental studies has been suggested that a higher dietary intake of carotenoids offers protection against developing certain cancers (e.g., lungs, skin, uterine, cervix, gastrointestinal tract), macular degeneration, cataracts, and other health conditions linked to oxidative or free radical damage (Rock, 1997). Special physiological activity of these compounds in human as the vitamin A precursors and also as antioxidants, causes increasing interest among researchers in determining their content in different products (Palace et al., 1999). Gibberellic acid is sometimes used in laboratory and greenhouse settings to trigger germination in seeds that would otherwise remain dormant. It is also widely used in the grape-growing industry as a hormone to induce the production of larger bundles and bigger grapes, especially Thompson seedless grapes were produced by GA3. Seedless melon also was produced nowadays by GA3. it is also used as a growth replicator in the cherry industry. It is used on Clementine Mandarin oranges, which may otherwise cross-pollinate with other citrus and grow undesirable seeds. (Wikipedia, 2013). Bethke et al. (2006). stated that cereal aleurone layer was investigated for studying the regulation of transcription by gibberellin (GA) and abscisic acid (ABA). GA stimulated and ABA prevented the transcription of genes for *α*-amylases and other secreted hydrolytic enzymes, but, still how GA and ABA affect the transcription of other genes is largely unknown. They characterized gene expression in rice (*Oryza sativa*) aleurone using a half-genome rice microarray. Among 23,000 probe sets on the chip, approximately 11,000 hybridized with RNA from rice aleurone treated with ABA, GA, or no hormone. They suggested that GA regulated the expression of many genes, and 3 times as many genes were up-regulated by GA at 8 h than were down-regulated. Changes in gene expression resulting from ABA treatment were not consistent with the hypothesis that the role of ABA in this tissue were primarily to repress gene expression, and 10 times more genes were up-regulated by ABA at 8 h than were down-regulated by ABA. They also measured transcript abundance in aleurone of *dwarf1* (*d1*) mutant rice. The d1 protein is the sole *α*-subunit of heterotrimeric G-proteins in rice. Genes up-regulated by GA or ABA had higher expression in wild type than in *d1* aleurone, and genes down-regulated by GA had lower expression in wild type relative to *d1* aleurone. The objective of the research was to identify the seedless effect of GA3 on pumpkin.

Materials and Methods

Plant Material

Pumpkin plants (local cultivar) were grown at the experimental Field, University of Malaya. Local cultivar is used. The fertilization was applied with the standard doses of N, P and K. All intercultural operations were done properly.

Treatment setting

Five plants were used for the concentration of 150ppm GA3 and five plants were used for the control. Injection

method by using syringe was used to make seedless pumkin or reduced seed by flower injection before blossoming (opening the flower).

Harvesting

The plant of the bushy growth of medium size fruits was harvested after 3 monthsof treatment application. Harvesting was done at physiologically green and mature stages.

Data collection

Fruit weight, seed weight and number were recorded.

Glucose content determination

Glucose was determined by using glucose refractometer. 3 drops of juice sample were put on the disc of the meter and data were displayed and recorded.

Inverted sugar determination

Inverted sugar was determined by using inverted sugar refractometer. 3 drops of juice sample were put on the disc of the meter using small syringe dropper and data were displayed and recorded.

Fructose content determination

Fructose content was determined by using fructose refractometer. 3 drops of juice sample were put on the disc of the meter and data were displayed and recorded.
pH was determined by Horiba Scientific pH meter (Japan).

Nutrient content determination

Nutrient content potassium (K) and calssium (Ca) were determined by Horiba Scientific potassium meter (Japan). 2-3 d drops of juice sample were put on the disc sensor of the meter using small dropper and data were displayed and recorded.

Results and Discussion

Figure 1 shows the difference between the seeded and seedless pumpkin. In the Table 1 it has been shown that fruit weight was higher in the GA3 treated fruit than in control. However, seed number and per seed weight were higher in the control than the GA3 treated pumpkin. Moreover, 96.9% seedless pumpkin was found by the treatment of GA3 compared to the control (Table 1). Glucose, inverted sugar and fructose content were found higher in the GA3 treated pumpkin than the control (Table 2). However, pH content was found higher in the control than GA3 treated fruit. In Table 3 it has been shown that potassium and calcium content were were higher in the GA3 treated fruit than in control.

It concludes from our results that positive results 96.9% seedless (Figure 1) fruit was found. Gibberellic acid is widely used in the grape-growing industry as a hormone to induce the production of larger bundles and bigger grapes, especially Thompson seedless grapes were produced by GA3 (USDA, 2009). It is stated that seedless melon also was produced nowadays by GA3, it is also used as a growth replicator in the cherry industry. It is used on Clementine Mandarin oranges, which may otherwise cross-pollinate with other citrus and grow undesirable seeds (Wikipedia, 2013). Bethke et al. (2006). stated that cereal aleurone layer was investigated for studying the regulation of transcription by gibberellin (GA) and abscisic acid (ABA). GA stimulated and ABA prevented the transcription of genes for α-amylases and other secreted hydrolytic enzymes. They also suggested that GA regulated the expression of many genes, and 3 times as many genes were up-regulated by GA at 8 h than were down-regulated. Thay also reported that genes up-regulated by GA had higher expression in wild type than in *d1* aleurone, and genes down-regulated by GA had lower expression in wild type relative to *d1* aleurone.

Conclusion

It concludes from our results that 96.9% seedless pumpkin can be produced by the use of GA3 150ppm.

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References

Abbott, J. 1999. Quality measurements of fruits and vegetables. Postharvest Biol. Technol. 15, 207-225.

Bethke, P.C. H Yong-sic , T. Zhu, and L.J. Russell. 2006. Global Patterns of Gene Expression in the Aleurone of Wild-Type and *dwarf1* Mutant Rice[1,[W]]Plant Physiol. 2006 February; 140(2): 484–498.

Palace, V. P., N. Khaper, Q. Qin, P. K. Singal. 1999, Antioxidant potentials of vitamin A and carotenoids and their relevance to heart disease. Free Rad. Biol. Med. 25, 746-761.

Rock, C. L. 1997. Carotenoids: biology and treatment. Pharmacol. Ther. 75, 185-97.

USDA, 2009. Database entry Percentages are roughly approximated using US recommendations for adults.. Source: USDA Nutrient Database. http://en.wikipedia.org/wiki/Pumpkin

Van het Hoff, K. H., B. C. de Boer, J. B. M. Tijburg, B. R. H. M. Lucius, I. Zijp, C. E. West, J. G. A. J. Hautvast, J. A. Westrate. 2000. Carotenoid bioavailability in humans from tomatoes processed in different ways determined from the carotenoid. J. Nutr. 130, 1189-1196.

Wikipedia. 2013. http://en.wikipedia.org/wiki/Gibberellic_acid

Annexure

Figure:

Pumkin with seed (Full ripen) Pumkin with seed (Green)

Seedless pumkim by GA3in maturity stage

Figure 1. Seedless pumpkin production by plant hormone application

Table page

Table 1. Pumpkin weight and seed number measurement

Treatment	Fruit weight (g)	Per Seed weight (mg)	Seed Number	% seedless
Control	700.5±0.5	13.3±0.2	98±0.5	0
GA3	750.4±0.6	6.6±0.1	3±0.1	96.9±0.1

Mean ± SE (N=5).

Table 2. Biochemical content like Glucose, inverted sugar and fructose determination

Treatment	Glucose content (%)	Inverted sugar content (%)	Fructose content (%)	pH
Control	5.0±0.3	4.3±0.2	7.0±0.5	6.9±0.1
GA3	5.9±0.2	4.8±0.3	7.6±0.5	6.8±0.1

Mean ± SE (N=5).

Table 3. Nutrient content like potassium and calcium content determination

Treatment	Potassium content (ppm)	Calcium content ppm)
Control	310.2±0.4	36.1±0.2
GA3	340.5±0.3	50.2±0.1

Mean ± SE (N=5).