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Determination of Endogenous GA_3 Levels in Different Parts of Artichoke (*Cynara scolymus* L. cv. Sakız) Plants in Various Developmental Stages

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Abstract: This study was conducted to reveal the levels of endogenous GA_3 in different parts of artichoke (*Cynara scolymus* L.). *Cynara scolymus* L. cv. Sakız, an important Turkish cultivar, was used as plant material. The levels of endogenous GA_3 on GA_3 treated and non-treated plants (control) were determined by High Performance Liquid Chromatography (HPLC) method. Experiment results revealed that the highest level of GA_3 was present on the plants treated with in 25 ppm GA_3 and had immature head. On the other hand it was found that the lowest level of GA_3 was present on the plants treated with 50 ppm GA_3 and had mature head.

Key words: *Globe artichoke*, endogenous GA_3, bolting, GA_3 treatment

INTRODUCTION

Artichoke, (*Cynara scolymus* L.) is one of the important and popular vegetable crop of Mediterranean countries. Artichoke is reported to be grown 1.327.811 Mt all around the world. Total production of the Mediterranean countries is 1096.689.000 Mt.[1]. It was reported that Mediterranean people introduced the artichoke in other parts of the world[2]. On the other hand the climatic needs of the crop restrict the growing regions. Italy, Spain, France and Argentina are the main artichoke producer countries[1]. While Italy ranks the first with 489.349 ton production and followed by Spain with 299.800 ton, Turkey's production is about 28.000 ton[1].

In Turkey, Aegean, Mediterranean and Marmara regions are the main artichoke producing regions. Aegean and Mediterranean regions have a special importance on artichoke growing because of their climatic advantages which favour the early production. There are two main cultivars of Turkey, namely Sakız and Bayrampaşa. Sakız cultivar comes forward since it is an early cultivar. Since early artichoke growing is quite profitable, many new plantations have been set up recently in Turkey[3].

The hormone gibberellin (GA) play essential role in many aspects of plant growth and development, such as seed germination, stem elongation and flower development[4]. The main action of gibberellins is promote elongation. Gibberellins are also involved in flowering and the bolting that proceeds it in rosette plants, in certain phases of seed germination, in the breaking of dormancy and several formative effects[5]. Gibberellins also interact in their effects with other hormones. Unlike auxins gibberellins seem to move freely about the plant and their transport and distribution patterns are not polar like those of auxins.

It is known that the kind and level of plant growth regulators show variation in different seasons. In addition to this fact it is also known that type and level of plant growth regulators may vary at different organs of the plant. It is important to know the type and level of GA and GA-like substances in order to shed more lights on exogenous hormone application[6].

The main aim of this present study was to determine the changes on the level of endogenous GA_3 on plants at various developmental stages which were subjected and non-subjected GA_3 on plants at various developmental stages which were subjected and non-subjected to exogenous GA_3 applications.

MATERIALS AND METHODS

Cynara scolymus L. cv. Sakız was used as plant material. Experiments were conducted at experimental field of Agricultural Faculty, Akdeniz University in 2001 growing period. Five weeks after awakening irrigation 25 ppm and 50 ppm GA_3 were applied and samples from different tissues of plants at various developmental stages were collected in order to determine the level of endogenous GA_3. Plants with no GA_3 applications were used as control group (0 ppm).

Samples were collected from different tissues of plants at varous developmental stages as down stated:

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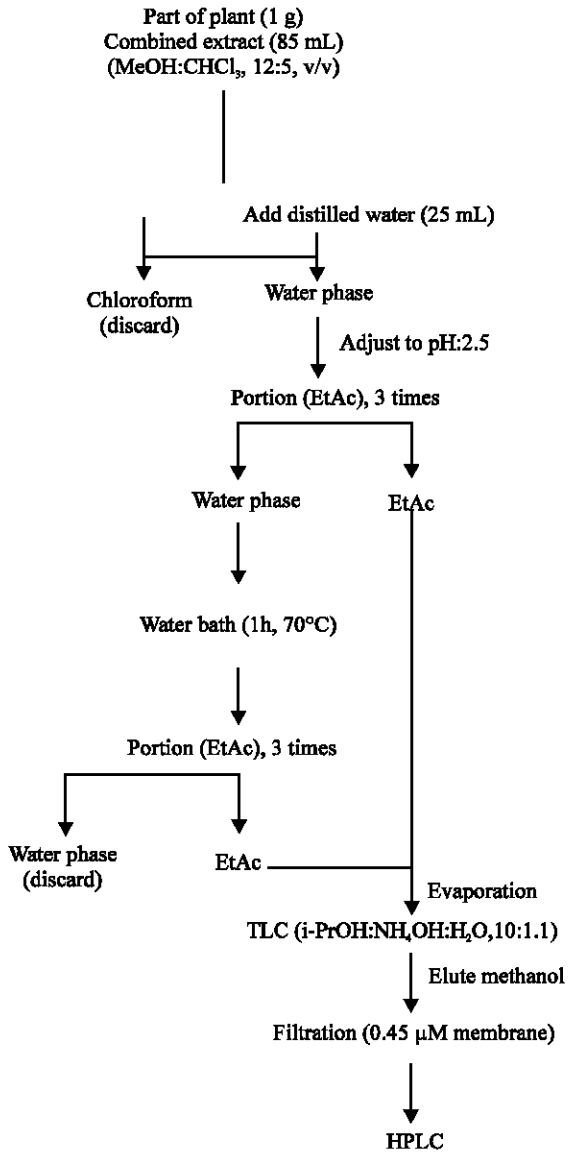

Fig. 1: Flow diagram outlining the extracts used in purification of GA_3 for HPLC

- Leaf samples collected from Young Plants (YP), 12.81 cm width, 44.9 cm length and have 6 true leaves.
- Immature head and leaves samples (18.97 cm width and 33.5 cm in length) collected from plants which formed Immature Head Plant (IHP).
- Mature head and leaves samples (22.38 cm in width; 39.83 cm length) collected from Mature Plants (MP)

GA analyses were conducted according to a method developed by Özgüven *et al.*[7], Paksoy *et al.*[8], Özgüven *et al.*[9], Ersoy and Kaynak[10] and Ersoy[6] with some minor modifications as stated in Fig. 1.

GA_3 analyses was performed in Shimadzu model HPLC equipped with UV-dedector (SPD-10 AV VP) and pump (LC-10 AD) and enabling the use of concentration gradient of the mobile phase. Separations and determinations were performed on Supel Cocil LC-18 column (25 cm x 4.6 mm and 10 µm) lengths in UV detector were 208 nm for HPLC analysis of GA_3. The flow rate was 1 mL min^{-1}. The GA_3 levels in the samples were compared to respond ratio of detector for sentetic GA_3 standard (Sigma).

RESULTS

Endogenous GA_3 level in leaf: The highest level of GA_3 was obtained as 2.71 µg g^{-1} on control plants which had immature head. On the other hand the level decreased to 0.26 µg g^{-1} on the mature plants which had mature head (Table 1).

In the case of plants subjected to GA_3 treatment, the highest level of GA_3 was obtained on the leaves of plants which had immature head (8.01 µg g^{-1}) and treated with 25 ppm GA_3 (Table 2).

While the leaves of mature plants, carrying mature head and treated with 25 ppm GA_3, had 0.75 µg g^{-1} GA_3, 0.57 µg g^{-1} GA_3 was obtained in young leaves. Statistical analyses revealed that the levels of endogenous GA_3 obtained from various tissues of the plant showed statistically significant differences (Table 1).

While the leaves of 50 ppm GA_3 applicated young plants had 2.42 µg g^{-1}, leaves of plants with immature head and mature head had the levels of 1.86 and 0.33 µg g^{-1} GA_3, respectively (Table 1).

Statistical analyses conducted on GA_3 applicated plants showed that there were statistically significant differences on the level of GA_3 at various parts and developmental stages of plants. According to results the highest level of GA_3 (8.01 µg g^{-1}) was obtained on 25 ppm

Table 1: Endogenous GA_3 levels compared to synthetic GA_3 standard in leaves of Sakız cultivar at various developmental stages

	Endogenous GA_3 levels (µg g^{-1})		
Applications	Young plant	Immature head plant	Mature plant
Control	0.81	2.71	0.26
25 ppm	0.57	8.01	0.75
50 ppm	2.42	1.86	0.33

Table 2: Endogenous GA_3 levels compared to synthetic GA_3 standard in heads of Sakız cultivar at various developmental stages

	Endogenous GA_3 levels (µg g^{-1})	
Applications	Immature head plant	Mature plant
Control	0.34	0.38
25 ppm	2.47	0.85
50 ppm	1.46	0.07

GA_3 applied plants, which had the immature head, the lowest one (0.33 μg g^{-1}) was obtained from the plants with had mature head. (Table 1).

Endogenous level of GA_3 in head: The highest level (2.47 μg g^{-1}) of GA_3 was obtained on the plants treated with 25 ppm GA_3 and had immature head. On the other hand the lowest value (0.07 μg g^{-1}) of GA_3 was obtained on the plants treated with 50 ppm GA_3 and had mature head (Table 2).

Results showing the levels of GA_3 in various parts of artichoke plants at various developmental stages are summarised in Table 2.

DISCUSSION

The control mechanism of apical dormancy have been studied by various researchers[11-13]. It was reported that the increase on concentrations of GA_3 and cytokinin in shoot tips induced the apical dormancy. Results of this present study are, therefore, in agreement with previous studies as endogenous GA_3 level in leaves of 25 ppm GA_3 applicated plants was higher than control plants. This increase caused to apical dormancy as it was shown in Table 1.

Several researchers reported that the concentration of GA_s and GA like compounds increased at long day conditions[14-16]. According to the results, applied GA_3 doses were not shown the effect of long-day conditions.

Zeevaart *et al.*[17] conducted an experiment on spinach and reported that synthesis of GA_3 and GA_3 like compound was increased by cold treatment and that caused to bolting. Dahanayake and Galwey[16] tried to explain the relationship between GA and bolting in *Brassica napus* var. Annua. He reported that GA_3 applications resulted with flowering. He reported that GA_3 application increased the level of endogenous GA_3 compared to control plants. Results obtained in this present study indicated that leaves of GA_3 treated all plants of various developmental stages (except the leaves of plants which had immature head) had higher level of GA_3 than control plants (Table 1).

REFERENCES

1. FAO., 2004. http://www.Fao.org. Statistical database.
2. Pecaut, P., 1993. Globe artichoke (*Cynara scolymus* L.) In: Kalloo, G. and B.O. Bergh (Eds.). Genetic Improvement of Vegetable Crops. Oxford, New York, Seoul, Tokyo.
3. Vural, H., D. Eşiyok and I. Duman, 2000. Kültür Sebzeleri (Vegetable Production). Egean University Press, Bornova, Izmir, Turkey.
4. Yamaguchi, S. and Y. Kamiya, 2000. Gibberellin biosynthesis : Its regulation by endogenous and environmental signals. Plant Cell Physiol., 41: 251-257.
5. Demeulemeester, M.A.C. and M.P. De Proft, 1999. Pith elongation in chicory (*Cichorium intybus* L.) heads: Influence of light breaks and daminozide. Sci. Hortic., 81: 437-442.
6. Ersoy, N., 2004. Determination of some endogenous plant hormones, carbohydrates and C/N ratios in loquat (*Eriobotrya japonica* Lindl.) leaves in the various developmental stages. Akdeniz Üniv. Fen Bilimleri Enst. Bahçe Bitkileri Anabilim Dalı, Doktora Tezi, pp: 93.
7. Özgüven, A.I., M. Paksoy and K. Abak, 1997. The effect of 4-CPA in tomato growing in greenhouse on the fruit set, quality and amount of 4-CPA residue in fruit. Proceeding of the 8th International Symposium on Plant Bioregulators in Fruit Production, Acta Hortic., 463: 243-248.
8. Paksoy, M., A.I. Özgüven, H. Tatlı and C. Yılmaz, 1998. The effect of 4-CPA in eggplant growing in greenhouse on the fruit set, quality and amount of 4-CPA residue in fruit. Çukurova Üniv. Ziraat Fak. Dergisi, 13: 141-148.
9. Özgüven, A.I., M. Paksoy, C. Yılmaz and H. Tatlı, 1998. The effect of 4-CPA in tomato cv. Galit F1 on the yield, earliness, quality and endogenous 4-CPA residue in fruit. Bahçe, 27: 73-84.
10. Ersoy, N. and L. Kaynak, 2003. Determination of endogenous GA_e level in loquat (*Eriobotrya japonica* Lindl.) leaves in the various physiological periods. IV. Ulusal Bahçe Bitkileri Kongresi, 8-12 Eylül, Akdeniz Üniversitesi Bahçe Bitkileri Anabilim Dalı, pp:157-158.
11. Cline, M.G., 1994. The role of hormones in apical dominance: New approaches to an old problem in plant development. Physiol. Plant., 90: 230-237.
12. Li, C.J. and F. Bangerth, 1992. The Possible Role of Cytokinins, Ethylene and Indoleacetic Acid in Apical Dominance. In: Karssen, C.M., van Loon, L.C. and D. Vreugdendil (Eds.), Progress in Plant Growth Regulation. Kluwer Academic Publishers, Netherlands, pp: 431-436.
13. Chen, J.G., H.Y. Zhao, X. Zhuo, L.S. Mao and X.X. Chen, 1997. Fluctuation in levels of endogenous hormones after decapitation and 6-benzyl amino purine treatment in azalea and their relationship to apical dominance. Sci. Hortic., 71: 49-58.

14. Hazebroek, J.P. and J.D. Metzger, 1990. Thermoinductive regulation of gibberellin metabolism in Thlapsi arvensi L. I. Metabolism of (^{2}H)-ent-Kaurenoic Acid (^{14}C) gibberellin A_{12}-aldehyde. Plant Physiol., 94: 157-165.
15. Metzger, J.D., 1990. Comparison of biological activities of gibberellin and gibberellin precursors Native *Thlapsi arvense* L. Plant Physiol., 94: 151-156.
16. Dahanayake, S.R. and N.W. Galwey, 1999. Effects of interaction between low-temperature treatments, gibberellin (GA_3) and photoperiod on flowering and stem height of spring rape (*Brassica napus* var. Annua). Ann. Bot., 84: 321-327.
17. Zeevaart, J.A.D., D.A. Gage and M. Talon, 1993. Gibberellin A1 is required for stem elongation in spinash. Proc. Natl. Acad. Sci. USA., 90: 7401-7405.