

Annals Of Agric. Sc., Moshtohor,
Vol. 43(2): 755-767, (2005).

STUDIES ON THE SPEARS MATURITY IN BROCCOLI
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ABSTRACT

Two experiments in 1993-1994 and 1994-1995 seasons were carried out at a private farm in Meniet El-Sebaa-Banha, Qalubia government, on broccoli cultivar "De Cicco" to study the physical and chemical changes in spears during development and storage for determining the maturity stage. The rate of increase in spear diameter, stem diameter and fresh weight started rapidly till 20 days after planting then a moderate increase occurred till last of the age. A quick accumulation in T.S.S., and chlorophyll up to the age of 20 days then a slow decrease trend in the last ages was noticed. The spears maturity stage of the variety "De Cicco" was reached after 20 days from bud formation which in the same time coincided with the most suitable age for harvesting.

INTRODUCTION

The wide area and the great advances in techniques and methods of broccoli spears production in Egypt during the last decades, perhaps open enormous pathways for exportation. In spite of some scientific papers on improving post harvest physiology of this crop have poured from foreign laboratories all over the world, there is a lack in the scope about this matter in our country which now a days is an emergent target. So, the determination of maturity stage was the most in this concern. Studies on the physical and chemical characteristics of the spears during storage may help in determining this stage of spears growth. Thus, a more objective approach to determine the maturity stage of spear came from evidences of some research works done during spear development. Thus, on some broccoli varieties, it was found that positive increase in head dimensions was seen with the progress of head development (Borchers, 1968). However, most observations on broccoli gave similar conclusion. For example, it was found in many tested varieties of broccoli that a gradual increase in head weight occurred till the preharvest periods then followed by a slight increase up to the harvest stage (Marshall and Thompson, 1987a and 1987b).

Concerning stem diameter, many evidences cleared that this character in cauliflower increased with age advance in a curve-linear shape (Salter, 1969)

Another picture was observed in cucumber fruits when ascorbic acid content increased in the early stages of growth then decreased considerably and consistently with age advance (Abd El-Ghaffar, 1964)

The chemical changes in chlorophyll content during broccoli spears development were studied in some varieties. Hence, a study on broccoli CV. Shogun (Tian *et al.*, 1995), showed that big amounts of these pigments were found in the spear, at the maturity stage then rapid breakdown followed with aging.

Considerable progress has been made to wards the determination of sugars in broccoli spears. It was found that these spears contained 5.9% sugars at maturity (Hassan, 1989).

Spear decay, as a criterion happened during storage, was affected by the age of the stored spears. For example, when broccoli spears at three stages of maturity were stored for 20 days the most mature spears proved to be the best from the stand point of keeping quality (Stork, 1981). On snap beans, the changes in T.S.S. were followed in different pod ages. The determinations showed that T.S.S. had a fluctuating behaviors in the various ages during room temperature storage (Shanan, 1967).

Concerning chlorophyll behavior during storage of different ages of broccoli spears, there was an agreement among the investigators that the green colour vanish gradually in all the examined ages with the extend of storage periods (Stork, 1981 and Tian *et al.*, 1995).

Changes in sugars during storage of different fruit ages were also followed in some vegetables. Thus, it is easy to detect that total sugars in various ages of winter white cabbage decreased during storage (Nilsson, 1993).

MATERIALS AND METHODS

The variety "Do Cicco" of broccoli (*Brassica oleracea L., var. italica plank*) was used in this investigation. Two trials were conducted in a private farm at Miniut El-Sebaa near Banha, Kalubia Governorate during the two successive winter seasons of 1993-1994 and 1994-1995, seasons to follow the spear developmental stages so as to determine the maturity stage. The soil type of this area is silt-loam.

A- Developmental stages:

Seeds were sown in seedbed on September 15th and transplants were shifted to the field on October 29th and 28th for the first and second experiments, respectively. The used spacings were 70cm apart in rows and 50cm between plants. When the buds begin to form spears they were labeled every 5 days starting from 20th and 14th December, uptill 14th and 8th January during the two seasons of 1993-1994 and 1994-1995, respectively. On 19th and 13th January in the previous two seasons, all labeled spears were harvested. Thus, there were spears of six ages, i.e. 5, 10, 15, 20, 25 and 30 days. The harvested spears were immediately transferred to post harvest laboratory which belong to the Department of Horticulture, Faculty of Agriculture, Al-Azhar University. The sound and healthy spears were chosen for the physical and chemical analysis on the following items:

- a. **Physical characteristics:** Spear diameter, stem diameter, and fresh weight.
- b. **Chemical characteristics:** Total soluble solids, ascorbic acid, total chlorophyll, total sugars, and dry weight.

B - Storage of the developmental stages:

Broccoli spears of 5, 10, 15, 20, 25, and 30 days age were stored under room temperature conditions at $20 \pm 2^\circ\text{C}$ and 52-56% R.H. They were placed in open cardboard carton boxes (30x20x10cm) in three replicates. Samples were taken at random from each replicate and were examined every 2 days for the following characteristics:

- a. **Physical changes:** Loss in weight and unmarketable spears percentages.
- b. **Chemical changes:** Total soluble solids, ascorbic acid, total chlorophyll, and total sugars.

Determination procedures:

a- Physical characteristics:

- 1- **Diameter:** The average diameter of the spear and its stem was estimated by vernier caliper in cm.
- 2- **Fresh weight:** The average weight of the spears was determined in g.
- 3- **Loss in weight percentage:** The percentage of loss in weight was calculated as follows:

$$\text{Loss in weight \%} = \frac{\text{Loss in weight at the sampling date}}{\text{The initial weight of spears}} \times 100$$

- 4- **Unmarketable percentage:** The percentage of unmarketable spears was determined according to the following equation:

$$\text{Unmarketable spears (\%)} = \frac{\text{Total number of unmarketable spears at the sampling date}}{\text{The initial number of spears}} \times 100$$

b - Chemical characteristics:

- 1- Total soluble solids percentage was determined by Abbe refractometer (A.O.A.C., 1980).
- 2- Ascorbic acid content was determined by using the dye 2,6 dichlorophenolindophenol method (A.O.A.C., 1980). The results were calculated as mg/100 g fresh weight.
- 3- Total chlorophylls concentration was determined as mg/100g fresh weight according to Robbelen method (1957).
- 4- Total sugars were determined adopting the colorimetric method for the determination of sugar and related substances according to Dubois *et al.* (1956). The results were calculated as g/100 dry weight.
- 5- Dry weight percentage was determined by weight. One hundred g. fresh spears was oven dried at 70°C till constant weight was reached. The results were calculated as g/100 g. fresh weight.

Statistical analysis:

The physical and chemical results of the spear developmental stages were statistically analyzed by using Goodness of fit Method (George, 1963).

RESULTS AND DISCUSSION

A- Developmental Stages:

The spear growth of broccoli var. "De Cicco" has been followed by measuring a number of physical and chemical attributes such as spear diameter, stem diameter, fresh weight, total soluble solids, ascorbic acid, total chlorophyll, total sugars and dry weight. Growth curves based on these measurements showed characteristic forms which have been the subject of our discussion.

a- Physical characteristics:

It is clear from Fig. (1-a) that there was an increase trend in spear diameter during the different developmental stages in both seasons of 1993-1994 and 1994-1995. These increases in diameter were statistically of the curve linear type. In other words, the spear diameter was characterized with a rapid growth from the period of 5 to 20 days age which was followed by a slow increments up to 30 days. However, it was obvious that the type of growth of broccoli spear may be classified as one cycle growth which mean a type of continuous growth.

The results of the changes in stem diameter during growth in the two seasons of 1993-1994 and 1994-1995 (Fig. 1-b) indicate clearly that there was a curve linear with aging. The obtained values of stem diameter reflected a sharp increase during the period from 5 to 20 days age then a slower increment was followed till the age of 30 days. However, the resulted curves for stem diameter coincided with those obtained for spear diameter.

From the statistical point of view. the data of spear weight (Fig. 1-c) clear that this character increased in curve linear type with aging in both seasons of 1993-1994 and 1994-1995. However, the figures exhibited a rapid increments in the initial periods of growth up to 25 days then followed by a moderate one till 30 days age.

b- Chemical characteristics:

The data obtained on the changes in T.S.S. during spear development in the two seasons of 1993-1994 and 1994-1995 (Fig. 2 -a) show that these contents increased rapidly till the age of 20 days then a slow decline followed establishing a curve linear type up to the last examining age. (30 days). This is agreement with (Abd El-Ghaffar, 1964) on cucumber.

The results of the changes in the spears ascorbic acid content during development in the two seasons of 1993-1994 and 1994-1995 (Fig. 2-b) suggest a curve linear relationship between vitamin concentrations and spear age. However, the resulted values show clearly that ascorbic acid content increased quickly with age advance till the age of 20 days after which a slight drop happened in the following last ages. (25 and 30 days).

The effect of aging on the total chlorophyll content in the spears during its development in both seasons of 1993-1994 and 1994-1995 (Fig. 2-c) exhibit that the green colour pigments increased rapidly up to the age of 20 days then a very quick lessen happened up to the final checked age of 30 days. This indicates, clearly that the age of 20 days contained the maximum values of total chlorophyll.

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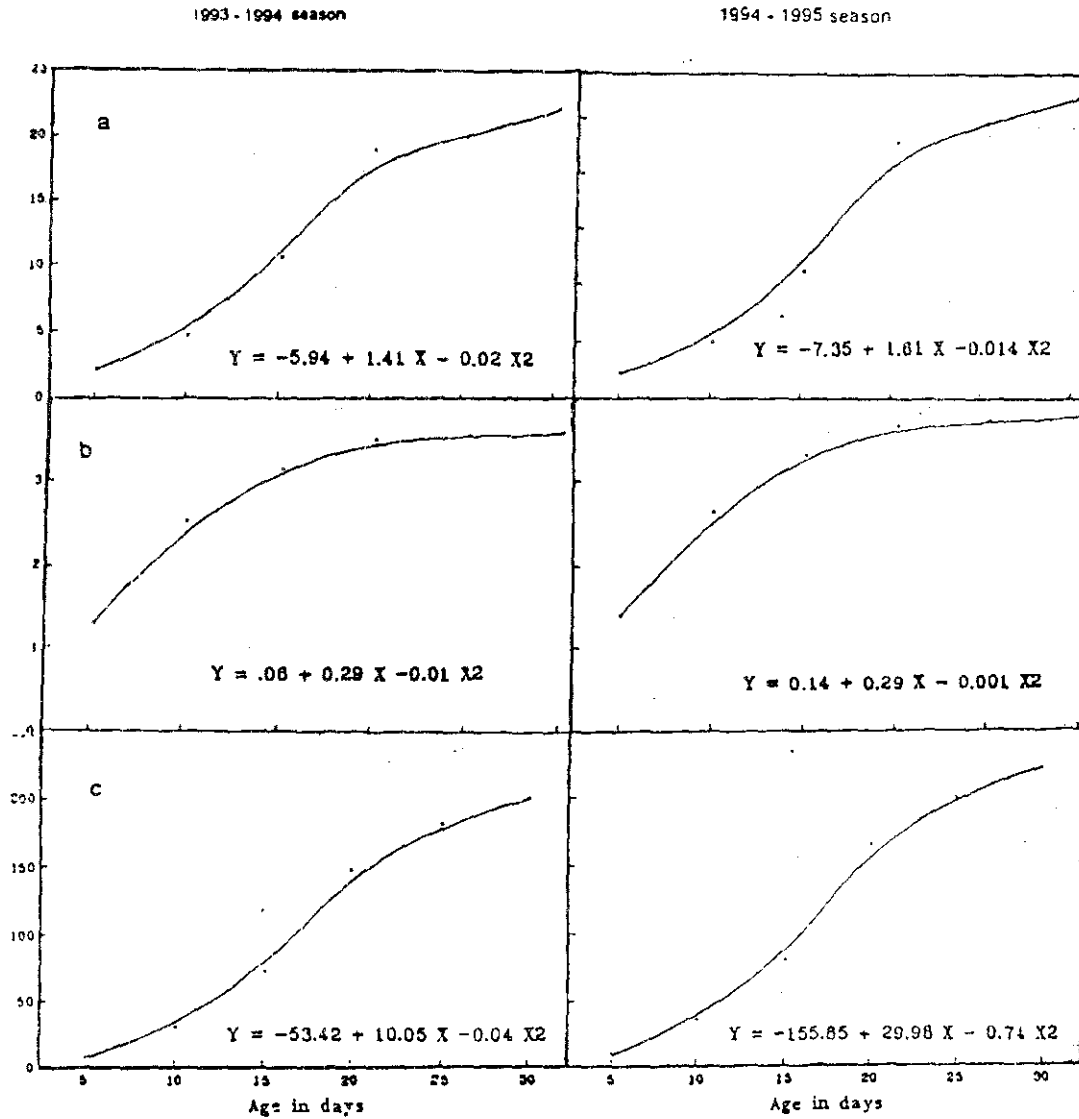


Fig (1) The spear physical changes during the various developmental stages in 1993 - 1994 and 1994 - 1995 seasons .

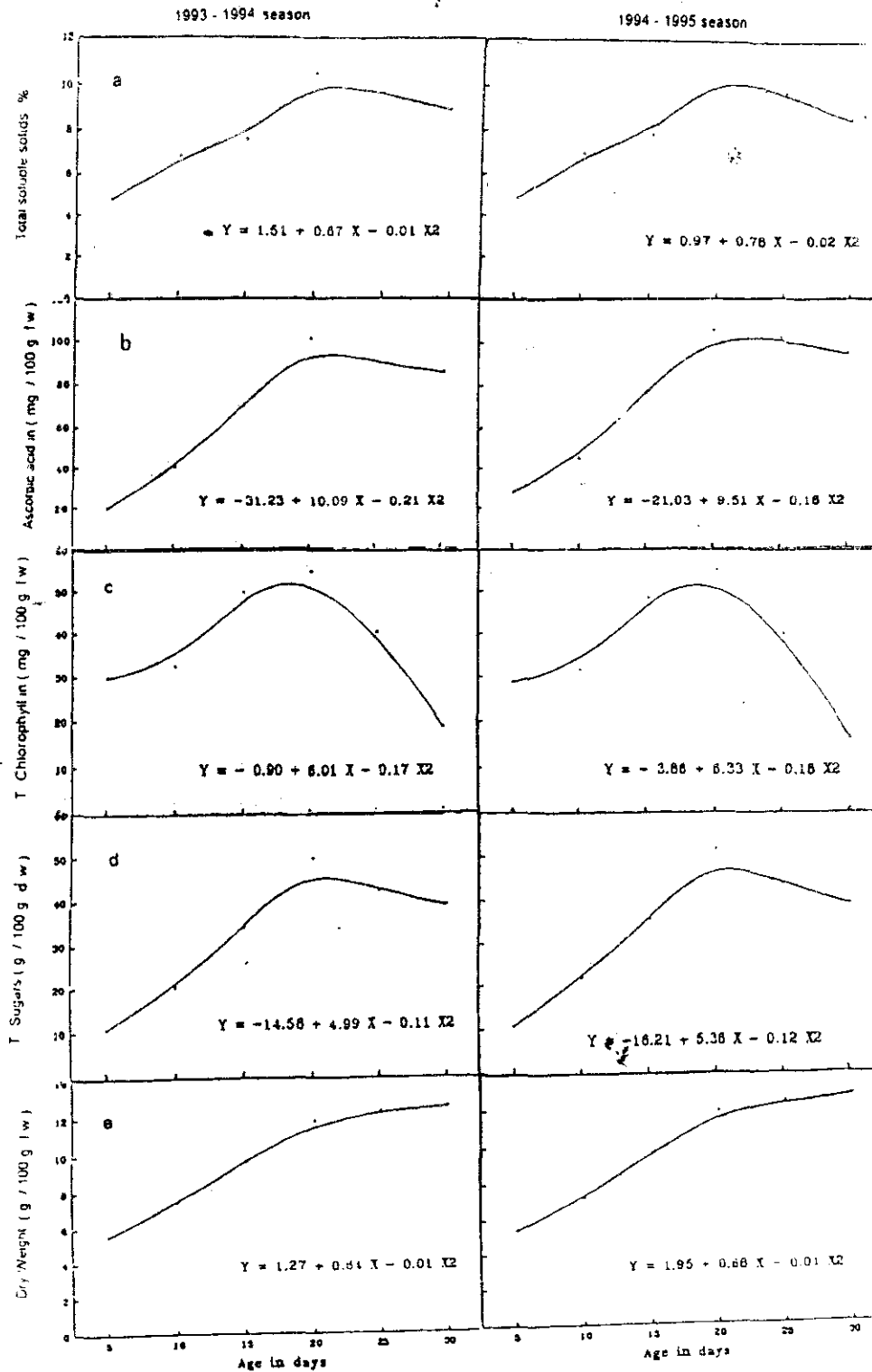


Fig (2) The spear chemical changes during the various developmental

The changes in total sugars during development of the spears in the two seasons of 1993-1994 and 1994-1995 (Fig. 2-d) indicate that these contents increased quickly and gradually with age advance till a peak reached in the age of 20 days. This peak was followed by a slow decrease trend in the last periods of growth. However, the trend of total sugars during spear development showed a curve linear type from the statistical point of view. This is agreement with (hassan, 1989) on broccoli.

B- Storage of developmental stages :

Recognition of the proper picking stage of the spears depends on the highest quality required for market accompanied with the ability to be stored for long periods. However, the fore mentioned basic data cleared the features of the various developmental ages of broccoli spears variety "De Cicco". More information in this chapter which endeavours to describe the behavior of the different spears ages during storage may enables us to determine the maturity stage of these spears.

a- Physical changes:

The results of the loss in weight percentage in the different stored spear ages (Table I) clear that a continuous loss in weight occurred with the extending of the storage periods in both seasons of 1993-1994 and 1994-1995. When the results of the various ages were put in comparison, the first demonstration is that the spears of 20 days age exhibited approximately the least loss during the various storage periods in the two seasons.

Table (1): Changes of the physical characteristics in the various spear developmental stages during storage.

Age in days	Storage periods in days							
	1993-1994 season				1994-1995 season			
	2	4	6	8	2	4	6	8
Losses in weight (%)								
5	15.50	33.70	61.40	-	17.50	35.8	62.60	-
10	9.90	19.50	40.30	-	10.30	20.40	43.10	-
15	9.30	15.40	27.80	-	9.80	16.50	28.90	-
20	6.90	11.20	23.20	33.90	7.40	12.20	24.10	34.80
25	6.90	13.20	25.20	-	7.30	14.40	26.20	-
30	6.40	12.50	23.90	-	7.10	13.20	25.40	-
Unmarketable spears (%)								
5	50	80	100	-	50	85	100	-
10	50	80	100	-	50	80	100	-
15	50	80	100	-	50	80	100	-
20	0	20	80	100	-	20	70	-
25	60	86.70	100	-	60	85	100	100
30	60	86.70	100	-	60	85	100	--

The data of the unmarketable spears percentage in the various stored developmental ages (Table 1) in both seasons of 1993-1994 and 1994-1995 clear that this percentage increased gradually in all the stored ages till the end of the storage periods. However, the results were in favor of those spears of 20 days age which exhibited the least percentage of unmarketable spears throughout the various storage periods.

The values in Table (2) show the effect of different storage periods on the T.S.S. content in the various developmental spear ages in the two seasons of 1993-1994 and 1994-1995. It is clear that, T.S.S. in all the stored spear ages exhibited a gradual decrease trend with the advance of storage periods. However, the spear age of 20 days kept the highest T.S.S. content during the various storage periods. This is agreement with (Shanan, 1976) on snap bean pods.

The changes happened during storage in ascorbic acid content in the various spear ages in the two seasons of 1993-1994 and 1994-1995 are shown in Table (2). It is obvious that ascorbic acid decreased in all the various ages as the storage periods elapsed. However, the most striking observation was noticed in the spears of 20 days age which dominantly kept the highest concentrations of this vitamin all over the storage periods.

Data pertaining to the total chlorophyll concentrations in the various stored spear ages during the two seasons of 1993-1994 and 1994-1995 clearly show a general gradual decrease in this content (Table 2). The most favorable result came from the spears of 20 days age which lost comparatively the least concentrations of this colour all over the storage periods.

Tabulated data in Table (2) show clearly the changes happened in the stored spears content of total sugars in the two seasons of 1993-1994 and 1994-1995. It is obvious that total sugars content in all the stored spear ages exhibited a gradual decrease trend with the advance of storage. However, it is apparent that the age of 20 days comparatively contained the highest total sugars during the whole storage periods than the other stored ages. These results agreement with (Nilsson, 1993) of winter weight cabbage.

C- Determination of the maturity stage:

When the results of the various stored ages were put in comparison, the first demonstration observed is that spears of 20 days exhibited the least loss in weight and the minimum percentage of unmarketable spear during storage. Also, it dominantly kept the highest concentrations of T.S.S., ascorbic acid, chlorophyll and total sugars during storage. Therefore, it can be concluded that the spear age of 20 days coincided with the maturity stage or the variety "De Cicco" of broccoli. This age was characterized with a range of 18.90 to 22.90 cm spear diameter, 3.50 to 3.65 cm stem diameter, 147.50 to 164.90 g weight, 10.60 to 10.90 %T.S.S., 100.70 to 105.20 mg/100 g fresh weight ascorbic acid, 54.60 to 55.10 mg/100 g fresh weight total chlorophyll, 49.70 to 50.90 g/100 g dry weight total sugars and 11.78 to 11.89 g/100 g fresh weight dry weight.

Table (2): Changes of the chemical characteristics in the various spear developmental stages during storage.

Age in days	Storage periods in days							
	1993-1994 season				1994-1995 season			
	0	2	4	6	0	2	4	6
T.S.S. %								
5	4.80	3.10	2.00	-	4.80	3.00	1.90	-
10	6.80	5.20	2.30	-	6.90	5.00	2.10	-
15	7.50	5.60	2.70	-	7.80	5.20	2.20	-
20	10.60	7.80	5.40	2.90	10.90	7.50	5.10	2.50
25	10.30	7.50	5.00	-	10.00	7.20	4.80	-
30	10.00	7.00	4.20	-	9.80	6.40	3.80	-
Ascorbic acid (mg./100g.f.w.)								
5	19.60	14.50	10.30	-	23.20	17.30	11.40	-
10	40.17	35.20	30.10	-	45.10	37.60	32.30	-
15	69.80	60.20	50.10	-	76.30	32.10	53.10	-
20	100.7	90.30	81.90	68.4	105.2	92.00	83.80	65.40
25	90.20	80.90	69.40	-	101.4	82.70	72.50	-
30	85.40	78.60	67.10	-	97.40	76.20	63.10	-
Total chlorophyll (mg./100g.f.w.)								
5	18.80	9.60	1.60	-	16.60	8.80	1.50	-
10	32.40	19.10	1.50	-	31.30	18.20	1.40	-
15	49.30	25.60	1.50	-	48.20	23.20	1.40	-
20	54.60	36.50	10.60	1.40	55.10	32.70	8.90	1.30
25	50.20	24.30	1.80	-	49.80	22.60	1.50	-
30	35.60	19.70	1.60	-	34.20	17.90	1.30	-
Total sugars (g.100 g.d.w.)								
5	10.70	6.30	3.30	-	10.50	6.80	3.00	-
10	20.00	13.30	7.40	-	21.30	12.50	7.20	-
15	34.00	22.70	12.80	-	35.30	20.60	11.70	-
20	49.70	40.30	30.10	19.50	50.90	41.40	29.70	18.60
25	42.30	31.60	20.40	-	43.20	30.10	18.20	-
30	39.00	25.30	15.30	-	38.20	26.70	17.00	-

On discussing the results of spear development, it is clear that both spear and stem diameter beside spear fresh weight were characterized with a rapid growth period from the age of 5 to 20 days for the first two characters and extended to 25 days for the third one. This was followed by a slow increments up to the last examining age of 30 days. However, it is quite possible to say that the increase in the physical characters of the spear may be attributed to the considerable cell expansion after the early period of cell division (Abo-EI-Hamd, 1981). From another point of view, the rapid and slow increases in the spear physical characters during its growth cycle may be physiologically explained through the work done on the fruits of watermelon by Pratt (1971) and tomato by Abd- EI-Rahman *et al.* (1975) who related these periods to the changes happened in the levels of IAA, GA3 and cytokinins. Our obtained results may clear that

these growth substances increased progressively in the first periods of spear growth then tended to lessen in the latter stages of development. The previous results are relatively in agreement with those found by some research workers during the development of broccoli spear diameters, and stem diameter (Borchers, 1968 and Salter 1969), stem diameter and fresh weight (Marshall and Thompson, 1987a, 1987b).

If we have a look to the obtained data of the chemical characteristics, the results of T.S.S. show a rapid increase up to 20 days age followed by a decline till the last age. However, it may be clear to our knowledge that the changes in T.S.S. during the growth of fruits, i.e. the spear here, are the resultant of some aspects such as the movement of water and soluble solids to and from the spear, the inversion of insoluble compounds to simpler soluble forms and respiration which may add or decrease these contents. So, the prevalence of one or more of these factors during fruit development may accumulate or lessen the contents of T.S.S. (Hulme, 1970).

The trend of ascorbic acid results resembled that it increased till the spear age of 20 days then a drop happened. To explain this trend, it is well known that ascorbic acid acts as a catalyst in respiration and in the same time it had important roles in the biological and biochemical oxidation-reduction reactions during the various vital processes occurring in the fruits (Ming-Long Liaw and Paul, 1987). On the other hand, the natural occurring ascorbic acid is L-ascorbic acid and the other ascorbic analogues. Fruits synthesis this vitamin in the precursor of hexose sugars which depends on an adequate photosynthetic activity (Hulme, 1970). Thus, nutritionally speaking, the increase in this vitamin during spear development may be due to the high rate of Hexose sugars synthesis and in the contrary the decrease may be attributed to its exhaustion during respiration and its transfer to the oxidized form.

Regarding the results of chlorophyll, it is obvious that the spread of this color in the spear took the same trend seen in both T.S.S. and ascorbic acid. However, it was established that some mature green tissues are capable of chlorophyll biosynthesis and the capacity to synthesize chlorophyll is probably a form of chlorophyll restoration (Buzsiz and Roheiz, 1978 and Tian *et al.*, 1995). On the other hand, the progressive diminish of chlorophyll with aging may be due to the continuous chlorophyllase activity in the breakdown of chlorophyll by catalyses the removal the phytol group (Hulme, 1970).

The favorite results came from the spears of 20 days age which exhibit the least loss during all these periods. The general trend of loss in weight, however, was expected because it was known that this criterion which happened during storage resulted from the loss of water by transpiration and the dry matter by respiration (Hulme, 1970).

The appearance of the unmarketable spears during storage of the various developmental ages was also expected. Best results were obtained from using spears of 20 days age because it showed the minimum percentage during the

whole storage periods. However, this feature may be attributed to the continuous chemical and biochemical changes happened in spears during storage which led to moisture condensation and trails-formation of complex compounds to simple forms of more liability to fungus infection, such as the change from the solid protopectin to the soluble pectin form (Pilnik and Voragen, 1970 and Stork, 1981).

Following the chemical changes in the various spear ages during storage, it is obvious that a general trend of decrease took place in the contents of T.S.S., ascorbic acid, chlorophyll and total sugars. However, the spear age of 20 days showed the least loss in these contents during storage. However, the question of the exerted decrease in T.S.S. may be accounted to the continuous loss in these contents through respiration (Hulme, 1970).

In explaining the decrease trend happened in ascorbic acid content during storage periods in all the stored spear ages, that ascorbic acid plays an important role as a catalyst in respiration and has vital part in the biological and biochemical oxidation- reduction reactions during the various processes occurring in stored fruits (Ming-Long Liao and Paul, 1987). thus, this universal component of plant cell which is especially abundant in tissues of high metabolic activity is rapidly oxidized at least by five enzyme systems (Hulme, 1970).

The diminish in spear chlorophyll content during storage may be cleared from the biochemical pathways of chlorophyll metabolism and lipid peroxidation. Evidences, however, suggested the involvement of at least four enzymes in the initial chlorophyll degradation (Hulm, 1970).

The gradual decrease in total sugars content during storage of spears may be attributed to its utilization in respiration (Whiting, 1970).

REFERENCES

- Abd-El-Ghaffar, A.A. (1964): Morphological, chemical and physiological changes during growth and storage of cucumber fruits. M.Sc. Thesis, Fac. Of Agric., Ain Shams Univ., Egypt.
- Abd-El-Rahman, M.; Thomas, T.H.; Doss, G.I. and Howell, L.H. (1975): Changes in endogenous plant hormones in cherry tomato fruits during development and maturation. *Plant Physiol.*, 34:39-43.
- Abo El-Hamd, A.S.A. (1981): Physiological studies on the developmental stages, handling and storage of tomato. Ph.D. Thesis, Fac. of Agric., Al-Azhar Univ., Egypt.
- Association of Official Analytical Chemical (1980): Official methods of Chemical analysis. The A.O.A.C., 12h ed. Published by A.O.A.C., Washington, D.C. 20044 U.S.A.
- Bazza, A.B. and Robeiz, C.A. (1978): Chloro culture: The chlorophyll repair potential of mature chloroplasts incubated in simple medium. *Bioch Biophys Acta*. 504:310.

- Borchers, E.A. (1968): Yield, uniformity of heading and season of maturity of broccoli inbreds, hybrids and varieties. Proc. Amer. Soc. Hort. Sci., 93: 351-355.
- Dubois, M.; Gilles, K.A.; Hailton, J.K.; Rebers, P.A. and Smith, F. (1956): Colorimetric method for determination of sugars and related substances Analytical Chemistry, 28: 350-356.
- George, B.A. (1963): Correlation and regression. A supplemented to "Experimental Methods for Extension Workers". University of California Agricultural Extension Service, U.S.A.
- Hassan, A.A. (1989): The secondary vegetables. E;-Dar El-Arabia of Publishing and Distribution. Cairo, Egypt, (in Arabic), 113-122.
- Hulme, A.C. (1970): The biochemistry of fruits and their products (1). Academic Press, London and New York, 1st Ed.
- Marshall, B. and Thompson, R. (1987a): A model of the influence of air temperature and solar radiation on the time to maturity of calabrese (*Brassica oleraceavar. Italic*). Annals of Botany, 60: 513-519.
- Marshall, B. and Thompson, R. (1987b): Application of a model to predict the time to maturity of calabrese (*Brassica oleracea var. italic*). Annals of Botany, 60:521-529.
- Ming Long Liao and Paul, S.A. (1987): Selected reactions of L-ascorbic acid related to foods. Food Technilogy, 41: 104-107.
- Nilsson, T. (1993): Influence of the time of harvest on keep ability and carbohydrate composition during long-term storage of winter white cabbage. J. Hort. Sci., 68: 71-78.
- Pilnik, W. and Voragen, A.G.J. (1970): The biochemistry of fruits and their products. Academic Press, London and New York, Vol. I, pp. 64-65.
- Pratt, H.K.C. (1971): The biochemistry of fruits and their products. Academic Press. London and New York. Pp. 207-232.
- Robbelen, G. (1957): Quantitative analysis of chloroplast pigments. Untersuchungen an strahlenin du Zierten blatter-bumtanten Von Arabidopsis Thaliana (L) vere bung 1 ehre, 88:189.
- Salter, P.J. (1969): Studies on crop maturity in cauliflower. 1. Relationship between the times of curd initiation and curd maturity of plants within a cauliflower crop. J. Hort. Sci., 44: 129-140.
- Shanan, S.A. (1967): Physiological studies on maturity, ripening, handling and storage of some leguminous crops. Ph.D. Thesis. Fac. Agric., Ain Shams Univ., Egypt 1967.
- Stork, H.W. (1981): Preserving the colour of broccoli. Groenten Fruit, 36:37. (Hort. Abstr., 52:200, 1982).
- Tian, M.; Davies, L.; Downs, C.G.; Liu, X.F. and Liil, R.E. (1995): Effect of florest maturity, cytokinin and ethylene on broccoli yellowing after harvest. Postharvest Biology and Tchnology, 6: 29-40.
- Whiting, G.C. (1970): The biochemistry of fruits and their products. Academic Press, London and New York, pp. 14-15.

دراسات على تحديد اكتمال نمو أقراص البروكلي

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أجريت هذه الدراسة على أقراص البروكلي صنف 'دي سيكو' لدراسة التغيرات الطبيعية والكيميائية خلال نموها وتخزينها لتحديد درجة اكتمال النمو والموعده المناسب للقطف. وقد تم زراعة نباتات التجربة خلال موسمي ١٩٩٤/١٩٩٣، ١٩٩٥/١٩٩٤ بجهة منية السباع بمحافظة القليوبية.

أ - دراسة مراحل نمو القرص: تم تعليم البراعم عند بداية تكوينها كل خمسة أيام للحصول على أقراص ذات أعمار ٥، ١٠، ١٥، ٢٠، ٢٥، ٣٠ يوماً لدراسة صفاتها الطبيعية والكيميائية، وكانت أهم النتائج المتحصل عليها فيما يلي:
زاد كل من قطر القرص، وقطر الساق القرصية زيادة سريعة بتقديم العمر حتى ٢٠ يوماً، ثم تبعته زيادة متوسطة حتى عمر ٣٠ يوماً، كان معدل الزيادة في الوزن الطازج للأقراص سريعاً حتى عمر ٢٥ يوماً ثم تبعته زيادة معتدلة حتى عمر ٣٠ يوماً، أما محتوى الأقراص من المواد الصلبة الذاتية الكلية، حامض الأسكوربيك، محتوى الكلوروفيل وكذلك السكريات الكلية ونسبة المادة الجافة فقد زادت خلال مراحل النمو حتى عمر ٢٠ يوماً ثم تبع ذلك نقصان في هذه المكونات الكيميائية في الأعمار الأخيرة.

ب - تحديد درجة اكتمال النمو ودرجة القطف المناسبة لهذا الصنف فقد خزنت الأعمار المابقة في صناديق كرتون مفتوحة تحت ظروف حرارة الغرفة (٢٠±٢م)، وتم تقدير بعض الصفات الطبيعية والكيميائية للأقراص كل يومين خلال التخزين. واتضح أن أقل نقص في الوزن وكذلك نسبة الأقراص الغير صالحة للتسويق كانت في العمر ٢٠ يوماً عن باقي الأعمار الصغيرة والكبيرة، كذلك كان أقل فقد في كل من المواد الصلبة الذاتية الكلية، وحامض الأسكوربيك وكذلك المحتوى من الكلوروفيل ونسبة السكريات والمادة الجافة الكلية للأقراص كان في العمر ٢٠ يوماً عن باقي الأعمار ولذلك يتضح من البحث أن أقراص البروكلي صنف 'دي سيكو' وصلت إلى مرحلة اكتمال النمو عند ٢٠ يوماً والذي كان في نفس الوقت أنسب عمر صالح للقطف.