Int.J.Curr.Microbiol.App.Sci (2022) *11*(10): 216-221

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 11 Number 10 (2022)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2022.1110.027

Effect of Carrot (*Daucus carota* L.) Root Extract on Meristematic Cells of *A. cepa* L.

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Keywords

Chromosomal abnormalities, Daucus carota, mitotic stimulator, root extract

Article Info

Received:
05 September 2022
Accepted:
30 September 2022
Available Online:
10 October 2022

A B S T R A C T

The effects of carrot root extract were investigated on meristematic cells of the roots of *A. cepa*. The growing roots of *A.cepa* were treated with five concentrations (100%, 75%, 50%, 25% and 10%) of the carrot root extract for 2, 4 and 6 hours respectively. The results showed that the low concentrations of the carrot root extract enhanced the mitotic activity but high concentrations were slightly mitodepressive in nature and induced some chromosomal abnormalities too like condensation of chromosomes, disturbed metaphases, scattered metaphases, chromatid separation, bridge formation, extrusion and disturbed polarity. It was concluded that carrot root extract was mitotic stimulator in nature but showed slight impact on chromosomal behavior.

Introduction

Carrot is a widely consumed root vegetable. Its botanical name is *Daucus carota* and it is the member of family Apiaceae (Umbelliferae). It is said to be the perfect vegetable for good health. It is crunchy, tasty, and highly nutritious. It is a good source of beta carotene, vitamin K1, several B vitamins, potassium, antioxidants and fibre. Beta carotene is converted into vitamin A inside the human body. This vitamin promotes good vision and is important for growth, development, and immune function. In recent years, the consumption of carrot and its products have increased steadily due to their recognition as an important source of natural antioxidants besides, anticancer activity of β-carotene being a precursor of vitamin A (Dreosti 1993; Speizer *et al*., 1999).

Raw carrot roots are used as salad or as vegetable to prepare various delicious dishes. A popular sweet dish in north India is 'Gajar ka Halwa' in which grated carrot roots are cooked in sweet milk until the whole mixture become semi solid. Carrot juice is a popular drink in north India during winters. Apart from its health benefits, its excessive consumption over a period of time can cause carotenemia, a yellow-orange discoloration of the skin caused by a build-up of carotenoids (Edigin, 2019). In view of its beneficial as well as harmful effects, the present

work is an effort to find out mitodepressive or cytotoxic activity, if any, of carrot root extract on root meristematic tissue of *Allium cepa*. Till now several plant extracts have been tested in relations to their mutagenicity and cytotoxicity such as onion (Kaushik and Yadav, 1993); tomato (Yadav *et al*., 2001); radish (Vaish and Saxena, 2017), and spinach (Vaish, 2021) and many more. The present paper throws light on the effects of carrot root extract on root meristematic cells of *Allium cepa*.

Materials and Methods

Carrot seeds were grown in the garden without using chemical fertilizers and pesticides. Fresh roots of carrot were collected and washed thoroughly, sliced and transferred into a juicer. The juice obtained was filtered to obtain the root extract. Four concentrations (10%, 25%, 50% and 75%) were prepared by dilution of root extract with distilled water. Root extract as 100% concentration was also tested for its effect on meristematic cells of the roots of *A. cepa*.

Allium cepa was taken as test material. The bulbs of the plant were grown in a tray containing sterile and moist sand to obtain secondary roots. When secondary roots developed, these were cut from few bulbs, fixed in Cornoy's fluid (Acetic-Alcohol in the ratio of 1:3) for 24 hours and then preserved in 70% alcohol for the study of control value of mitotic index for their meristematic cells. The other bulbs were transferred to the jars containing 100%, 75%, 50%, 25% and 10% concentrations of the carrot root extract. The treatment of each concentration was given to the roots for the duration of 2, 4 and 6 hours. All the treatments were carried out at 22-25^{0}C. After each treatment, root tips were cut and fixed in Cornoy's fluid for 24 hours and then transferred to 70% alcohol for preservation. These root tips were hydrolyzed by 1N HCl for 3 minutes and squashed in 2% acetocarmine for cytological studies. The slides were sealed temporarily, examined and micro photographed. Mitotic index was calculated by using the method of Mousa (1982). Chromosomal abnormalities, if any and their percentage in each concentration and duration were also recorded.

Results and Discussion

The aqueous solution of root extract of *Daucus carota* L. showed a stimulatory effect on mitotic activity of *A. cepa* L. root meristem. The value of mitotic index in controlled conditions was 17.25% (Table1 and Graph 1). When the root tips were treated by three concentrations (10%, 25% and 50%) for 2 hours duration, the mitotic index increased from 17.50% in 10% concentration to 19.77% in 50% concentration. Similarly, when root tips were exposed for 4 hours, the mitotic index again increased from 17.87% in 10% concentration to 19.10% in 25% concentration. During 6 hours treatment 10%, 25% and 50% concentrations also showed stimulatory effect on mitotic activity but higher concentrations (75% and 100%) were found to be slight mitodepressive. This slight decrease in mitotic index may be due to the presence of proto-alkaloids daucine and pyrrolidine. Almost similar effects were studied by Kaushik (1993) when he tested the extract of *Curcuma longa* rhizome on mitotic activity of *A. cepa, V. faba* and *N. mirabilis.* Similarly, El-Bayoumi *et al*., (1979) reported that papaverine hydrochloride increased the mitotic index after long periods of treatments with low concentrations but higher concentrations for long period of treatments decreased the mitotic index of *A. cepa* root tip cells. It has been concluded that carrot root extract is almost mitotic stimulator except a few exceptions.

During the study, some chromosomal aberrations were also recorded but these were not frequent.

At interphase, no nuclear or chromosomal aberration was recorded.

At prophase, only condensation of chromosomes (Photoplate1) was observed in higher concentrations. The maximum percentage of condensation was 3.70 studied in 100% concentration.

Table.1 Mitotic index, frequency of aberrations and their percentage as induced by root extract of *Daucus carota* L. on *A. cepa* L. (2n = 16)

Concentration	**10%**				**25%**				**50%**				**75%**				**100%**				**Control**		
Duration (in hrs.)	**2**	**4**	**6**	**% of abr. (conc. wise)**	**2**	**4**	**6**	**% of abr. (conc. wise)**	**2**	**4**	**6**	**% of abr. (conc. wise)**	**2**	**4**	**6**	**% of abr. (conc. wise)**	**2**	**4**	**6**	**% of abr. (conc. wise)**	**2**	**4**	**6**
Mitotic index (in %)	17.50	17.87	18.16		18.63	19.10	19.37		19.77	19.52	19.83		18.60	18.33	17.16		17.89	17.16	16.73		17.25	17.25	17.25
Types of aberrations																					NO ABERRATION		
Con. 'P'	-	-	-	-	-	-	-	-	-	Con. 'P'	-	1.72	Con. 'P'	-	-	1.88	Con. 'P'	Con. 'P'	-	3.70			
C.S.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C.S.	3.57			
D. 'M'	-	-	-	-	-	-	-	-	D. 'M'	-	-	2.32	-	D. 'M'	-	2.56	-	D. 'M'	-	3.57			
Sc. 'M'	-	-	-	-	-	-	Sc. 'M'	2.32	-	-	Sc. 'M'	2.32	-	Sc. 'M'	-	5.12	-	-	Sc. 'M'	3.57			
Bri 'A'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Bri 'A'	3.12			
D.P. 'A'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	D.P. 'A'	D.P. 'A'	6.25			
Ex. 'A'	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Ex. 'A'	3.12			

Abbreviations: Con. 'P'- Condensation at Prophase, C.S.- Chromatid Separation, D. 'M'- Disturbed Metaphase, Sc. 'M'- Scattered Metaphase, Bri. 'A'- Bridge at Anaphase, D.P. 'A'- Disturbed Polarity at Anaphase, Ex. 'A'- Extrusion at Anaphase.

Graph.1

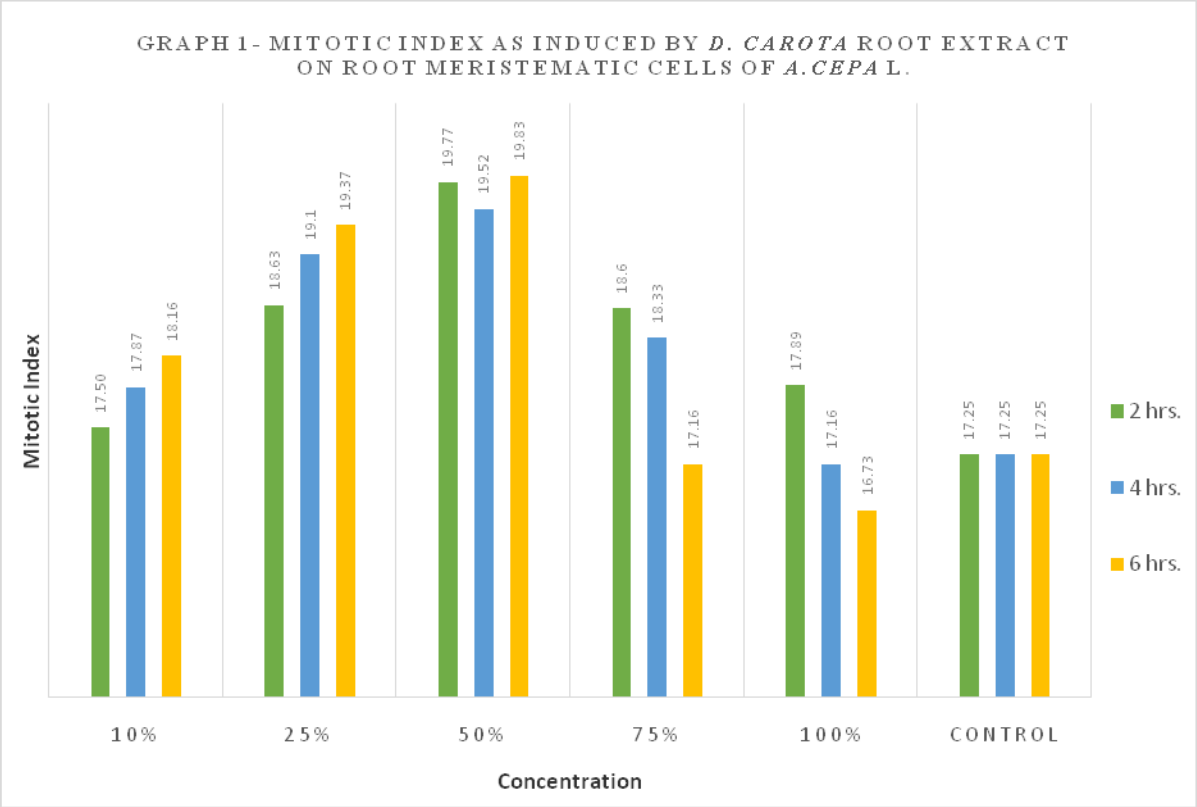
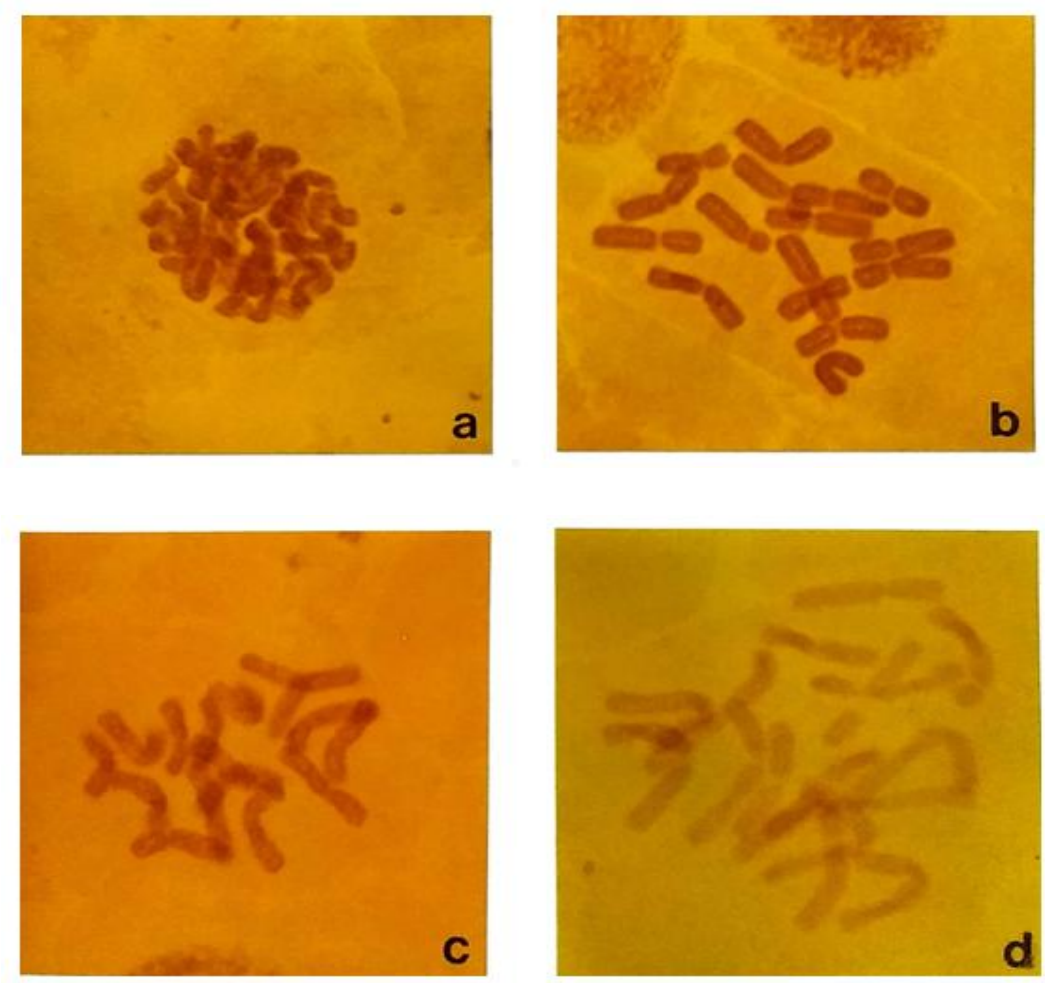

GRAPH 1- MITOTIC INDEX AS INDUCED BY D. CAROTA ROOT EXTRACT ON ROOT MERISTEMATIC CELLS OF A.CEPA L.
Mitotic Index
17.50
17.87
18.16
18.63
19.1
19.37
19.77
19.52
19.83
18.6
18.33
17.16
17.89
17.16
16.73
17.25
17.25
17.25
10%
25%
50%
75%
100%
CONTROL
Concentration
2 hrs.
4 hrs.
6 hrs.

Photo.1 a. Condensation at Prophase, b. Chromatid Separation, c. Disturbed Metaphase, d. Scattered Metaphase.



During metaphase, only three types of chromosomal aberrations were studied, but these were noticed only in roots treated by higher concentrations of carrot root extract. Disturbed metaphases were not observed in 10% and 25% concentrations while from 50% to 100% concentrations, the percentage of disturbed metaphases (Photoplate-1) increased and highest value was recorded 3.57. Scattered metaphases (Photoplate-1) were observed in all concentrations except 10% concentration. The percentage of scattered metaphases in both 25% and 50% concentrations were same as 2.32 but in 75% concentration, it increased up to 5.12 and again dropped to 3.57 in 100% concentration. Chromatid separation at metaphase was observed only in 100% concentration and its percentage was 3.57. Anaphase showed bridges, extrusion of chromosomes and disturbed polarity. At anaphase, all the three types of aberrations were observed only in the roots treated by 100% concentration of carrot root extract. The percentage value of both bridge formation and extrusion of chromosome was 3.12 whereas percentage of disturbed polarity was 6.25 (Table 1 and Graph 1).

No aberration was recorded at telophase.

It has been concluded that carrot root extract is mitotic stimulator in nature but also shows slight impact on chromosomal behavior only when onion

root tips were treated with higher concentrations of the carrot root extract. Several studies pointed out that chromosomal aberrations serve as elegant indicator of mutation. On the contrary, the antimutagenic potentiality of carrot root extract has also been studied by Nakshima (1989); Noriega *et al*., (1990) and Kalaycioglu *et al*., (1994). But Sarkar (1996) *et al*., suggested that both mutagen and antimutagen can be extracted from the same plant extract depending on the nature of solvents used for extraction.

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How to cite this article:

Amit Vaish. 2022. Effect of Carrot (*Daucus carota* L.) Root Extract on Meristematic Cells of *A. cepa* L.. *Int.J.Curr.Microbiol.App.Sci.* 11(10): 216-221. doi: https://doi.org/10.20546/ijcmas.2022.1110.027