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Mono and Bi-Cationic Effect on the Concentration of Carbohydrates in Maize Plant (Zea mays L.) Incubated Seedlings

A. Malo and N. Hamza*

Department of Chemistry, Faculty of Sciences, University of Damascus, Syria

***Corres.author: nice_nana2010@hotmail.com**

Abstract: This research aims to determine the amount of the carbohydrates dissolved in ethanol(hexoses and pentoses),complex carbohydrates (starch),structural carbohydrates (cellulose) in stems cells seedlings of maize plant (GHOTA 82) after growth period lasted for 6 days in water medium and incubated salty medium of Mg^{2+}, K^{+} and Na^{+} ions at graded concentrations.
The obtained results showed that the selected samples of non-organic ions have an inhibitory effect on the metabolism of the previous carbohydrates types of compared with water medium samples. This effect depends on the type and concentration of the ion in medium of incubation.
Keywords: carbohydrates, Mono and bi-cationic, incubation, Seedlings.

Introduction

Several research and Biochemical studies included the Structural changes that occur in plant as a result growth in inappropriate medium of metal salts, which cause one kinds of plant stress. Part of the focus of this research to study the changes in carbohydrates concentration by effect of inorganic ions salts, high concentrations of sodium ions to decreased concentration of carbohydrates in plant seedlings beans (*alfafa*) [1], and decreased of starch,total carbohydrates concentration in Canola*(Brassica napus L.)* [2], While increased in endosperm high concentrations of botassium ions lead to decreased concentration of carbohydrates in shoots and roots of) *Curcuma longa L.*(plant [3].

As well as decrease the concentration of carbohydrates in Wheat (*Triticumaestivum L. cv. Jubilar*) roots [4], and (*Lonicera japonica.*) plant, with increasing concentration of calciume ions in medium [5].

With increasing concentration of Magnisiume ions in medium, content of carbohydrates increase in (*Picea abies*) seedlings [6] Sugar beet (*Beta vulgaris* L. *cv. Monohill*) roots [7].

Materials and Methods

Materials

Maize plant seeds (GHOTA 82), sulfuric acid, hedro chloric acid, ethanol, $FeCl_3$, and metal salts :

KCL at concentration (1,2,3, 6, g/l) .

NaCL at concentration (1,2,3 g/l) .

$MgCL_2$ at concentration (1,2,3,6,9 g/l).

All the chemical materials from Merc Company

Anthron reagent (Anthron : C14H10O):

Anthron reagent reacts with the hexoses forming a complex blue – greenish. Dissolve 200 mg of anthron crystals in 100 ml of H2SO4 (83%),and then cooled[8].

Orcinol reagent or(Bial's Reagent):

Dissolve 3 g orcinol in 500 mL concentrated HCl, add 2.5 mL of a 10% solution of ferric chloride hexahydrate, and dilute to one liter with water; this is approximately 6 M HCl. When 1 mL of reagent is heated with 5 drops of sample in a boiling water bath, a positive test for pentoses is formation of a green to blue color (not precipitate) in less than five minutes [8].

Devices:

- Spectrophotometer (Vis-7220)
- Incubator (Philipharris)
- Incubator and shaker (G.F.L- 3031)
- Centrifuges (Boeco - U32R)

Methods

For seedling used in the research, maize seeds are soaked with for 3 hours at 50 Cº, then grown in the dark with continuous ventilation at 30 Cº

Preparation plant sections

Seedling clips taken 1cm long and the same place in the area under the node and above seed, Weighed one gram of plant sections, to extract and carbohydrates calibration.

Extraction of carbohydrates from clips seedling

Hexoses and pintoses dissolved extracted by 82% ethanol solution, Then the evaporation of ethanol**,** Solve the precipitate with distilled water and to a certain size complements**.**

Starch and pintozanes

These are extracted by sulfuric acid solution (1.5N) and completes the volume with distilled water**.** The structural polysaccharides such as cellulose extracted by acid hydrolysis with boiling**,** used for this purpose sulfuric acid solution 80.7%.

Calibration of carbohydrates

Hexoses Calibrated by anthron detector, where the complex is formed in green, measured intensity of the absorbance at 620 nm wavelength, After taking 5ml of anthron in a test tube with 1ml of sample, and after a good combination put it in boiling water bath for exactly 10 minutes, Then immediately cooled in an ice bath.

Pintoses Calibrated by orcinol detector, where the complex is formed in blue, measured intensity of the absorbance at 660 nm wavelength, After taking 3ml of orcinol in a test tube with 1ml of sample, and after a good combination put it in boiling water bath for exactly 30 minutes.

Discussion of Results

The Effect of Potassium Ions on Carbohydrate Groups in Maize Seedlings

This study aims to measure the effect of potassium chloride at concentration (1,2,3,6g/l) on the changes in carbohydrates groups concentration in maize seedlings which were grown in water and incubated in the medium of potassium chloride concentrations previously mentioned for 24 hours and during a period of six days .

Dissolved Carbohydrates

These include hexosese and pintoses dissolved in ethanol. The seedlings grown in water were put in a dark room at temperature 30 C° for six days, then were incubated in the medium of potassium chloride for 24 hours, at (1, 2, 3,6 g/l) concentration. Then, hexosese and pintoses were calibrated by anthron and orcinol detector, as shown in table (1), figure (1):

Results of Calibration:

Table (1) effect of Potassiume ions on hexoses and pentoses in seedlings,at gradual Concentrations

Concentration g/l	Control	H_2O	K^+				
			1	2	3	6	9
Hexosese mlg/g	15.3	11.6	5.6	6.5	8.7	11.8	-
Disintegration		24.2	63.4	57.52	43.14	22.88	
Pintoses mlg/g	7.7	3.8	3.5	4.4	5.83	6.7	-
Disintegration		50.65	54.55	42.86	24.29	12.99	

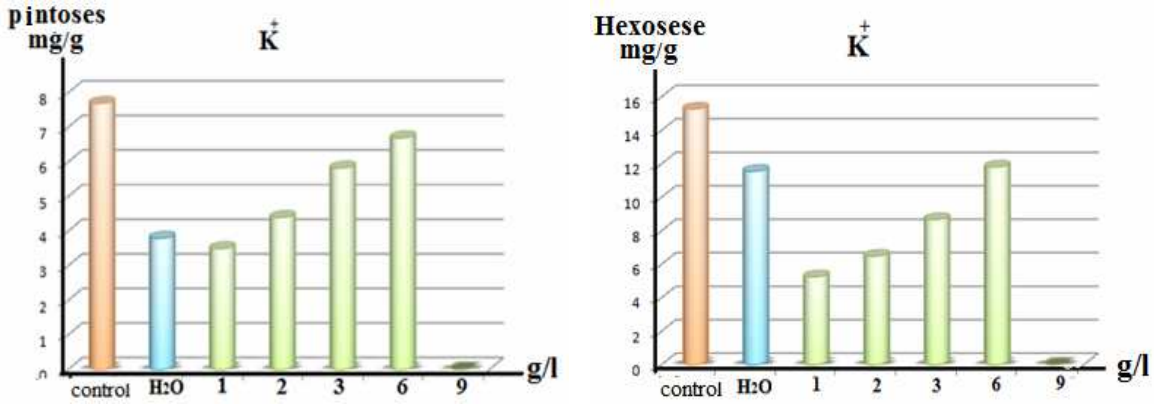


Figure (1) effect of Potassiume ions on hexoses and pentoses in seedlings,at gradual Concentrations

When the carbohydrates of seedlings stems cells were analyzed, the concentration of hexosese and pintoses in cells grown in water medium(control) was 15.3 mg/l and 7.7 mg/l respectively. When comparing the concentration of hexosese and pintoses in seedlings incubated in water medium with control, their concentration has decreased to 24.2% for hexosese and 50.56% for pintoses, while the disintegration was 63.4% for hexosese, and 54.55% for pintoses at (1g/l) concentration. And reached concentration of hexosese and pintoses to 57.52% for hexosese and 42.86% for pintoses at (2 g/l) concentration. Then the concentration of hexosese and pintoses continued to decrease to22.88% for hexosese and 12.99 % for pintoses at (6 g/l) concentration, compared with control, The concentration (9 g/l) had an inhibitory effect on the seeds growth.

Easy Dissolved Carbohydrates and Hydrolysis

These include starch and pentosans. Changes on the concentration of these seedlings carbohydrates grown in water medium and the solutions of potassium ions have been followed up according to the above mentioned conditions; the following as shown in table (2), figure (2).

Table (2) effect of Potassiume ions on starch and pentosans in seedlings,at gradual Concentrations

Concentration g/l	Control	H_2O	K^+				
			1	2	3	6	9
starch mg/g	16.4	7.5	0.87	2.16	4.82	9.86	-
Disintegration		54.27	94.7	86.83	70.61	39.88	
pentosans mg/g	4.51	2.8	0.7	1	1.23	3.56	-
Disintegration		37.92	84.48	77.83	72.73	21.06	

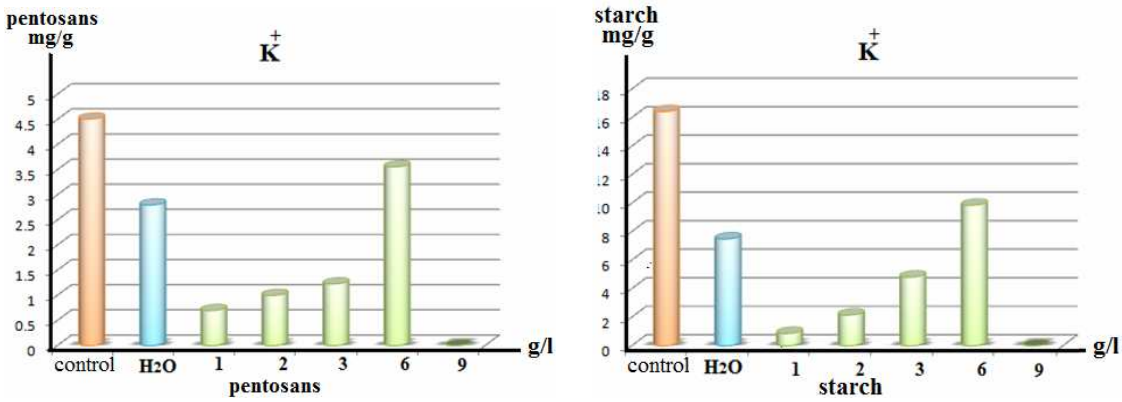


Figure (2) effect of Potassiume ions on starch and pentosans in seedlings,at gradual Concentrations

The starch and pentosans concentration in the seedlings stems cells has shown similar effect on carbohydrates dissolved in ethanol; where the concentration of these compounds decreased in stems cells to 94.7% for starch, and 84.48% for pentosans due to the effect of potassium ions at (1g/l) concentration. The amount of starch and pentosans continued to decrease to 21.6% at (6 g/l) concentration , compared with control.

Cellulose

These include cellulose and hemicelluloses. Its functional role is to form structures of plants, and it is characterized by complexity of providing the necessary strength during the formation of cellular walls, therefore it is extracted by highly concentrated acid hydrolysis, then the glucose resulted from hydrolysis by anthron detector was calibrated. Results of calibration are shown in table (3), figure (3) :

Table (3) effect of Potassiume ions on cellulose in seedlings,at gradual Concentrations

concentration	Control	H_2O	K^+				
			1	2	3	6	9
cellulose mlg/g	22.9	8.4	1.36	4.79	5.56	14.6	0
Disintegration		63.3	94.1	79.1	75.7	36.2	0

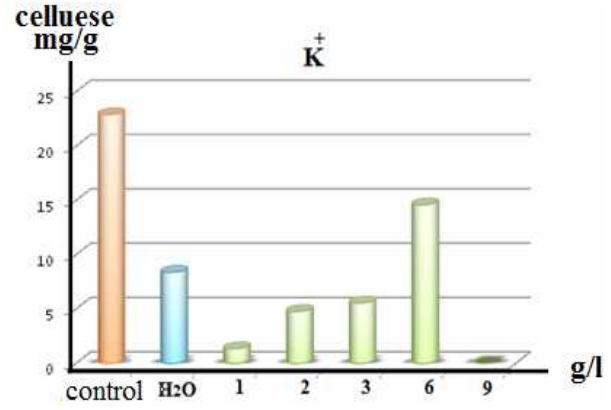


Figure (3) effect of Potassiume ions on cellulose in seedlings,at gradual Concentrations

The results show that when cellulose was calibrated, its concentration in seedlings which were grown in water according to the above mentioned conditions at the control were 22.9 mg/l; and it has decreased to 94.1% when the seedlings were incubated in water medium compared with the primal state. The cellulose concentration continued to decrease to 36.2% at (6 g/l) compared with the control.

The Effect of Sodium Ions on Carbohydrate Groups in Maize Seedlings:

To follow up the previous study, a comparison has been made between the effect of each of potassium and sodium chloride at (1,2,3, g/l) concentration on the changes in the concentration of carbohydrates groups in

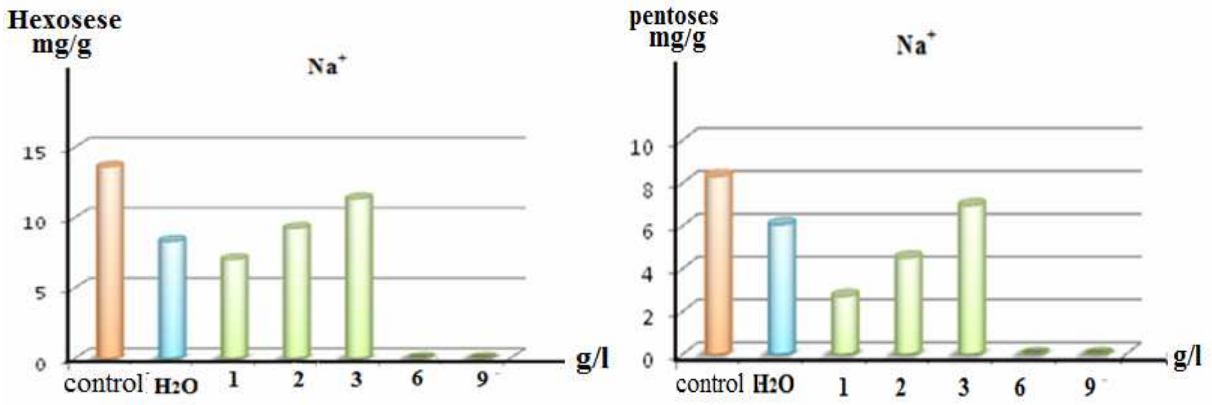
maize seedlings grown in water medium for six days and incubated in the medium of sodium chloride at concentrations mentioned above.

Dissolved Carbohydrates

After the calibration of these carbohydrates was finished according to the method adopted, the table (4) and Figures (4) show the results that were obtained:

Table(4) effect of sodium ions on Hexosese and Pintoses in seedlings,at gradual Concentrations

Concentration	Control		Na^+				
		H_2O	1	2	3	6	9
Hexosese mg/g	15.27	11.55	7.01	9.23	11.33	-	-
Disintegration		24.5	54.18	39.7	25.95		
Pintoses mg/g	7.66	3.7	1.7	2.5	3.33	-	-
Disintegration		51.5	77.7	67.2	56.5		



Figures (4) effect of sodium ions on Hexosese and Pintoses in seedlings,at gradual Concentrations

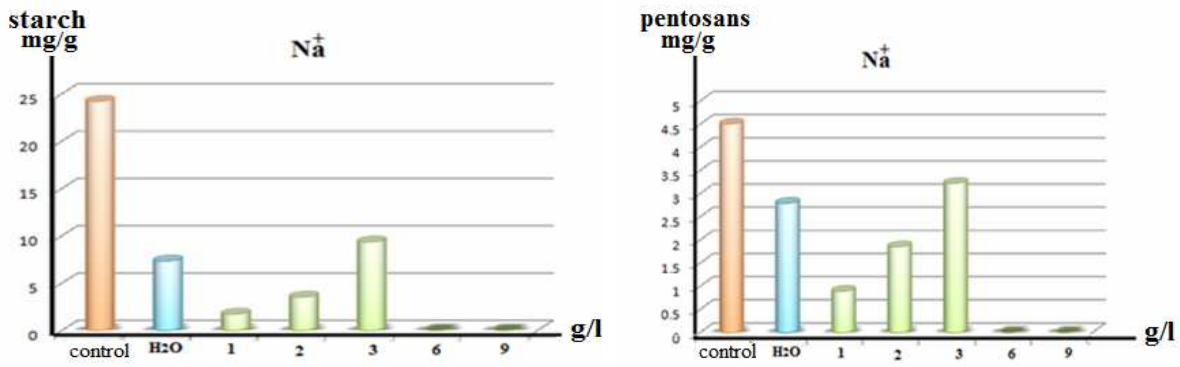
The results show that the concentration of hexoses and pentoses in seedlings grown in water medium for six days has decreased to 24.5% for hexoses, 51.5% for pintoses, and when they were incubated in sodium ions salts the concentration decreased to 54.18% for hexoses,77.7% for pintoses at (1g/l) concentration. Therefore; whenever the concentration of sodium ions has increased in the incubation medium ; the reduction of hexoses and pentoses concentration in seedlings grown in water according to the previous conditions decreases to 25.95 %for hexoses, and 56.5% for pintoses at (3g/l) concentration compared with incubation of seedlings in water medium .

Easy Dissolved Carbohydrates and Hydrolysis

Figures and table (5) show the results that were obtained when calibrating this type of carbohydrates.

Table (5) effect of sodium ions on starch and pentosans in seedlings,at gradual Concentrations

Concentration g/l	Control	H_2O	Na^+				
			1	2	3	6	9
starch	16.5	7.4	1.73	3.54	9.36	0	0
Disintegration		69.68	92.85	85.38	61.34		
pentosans	4.51	2.8	0.9	1.86	3.23	0	0
Disintegration		37.9	80.0	58.8	28.4		



Figures (5) effect of sodium ions on starch and pentosans in seedlings at gradual Concentrations

The results of starch and pentosans concentration calibration in seedlings grown in water medium for six days at incubation of seedlings in water medium show the disintegration of these compounds to 69.68% for starch, 37.9% for pentosans, compared with control while starch and pentosans disintegration was decreased when seedlings were incubated in sodium ions medium to 92.85% for starch and 80.0% for pentosans at (1g/l) concentration. The concentration of sodium ions at (3g/l) caused a reduction reached85.38 % for starch and 58.8% for pentosans and the disintegration increased to 61.34% for starch and 28.4% for pentosants, compared with control.

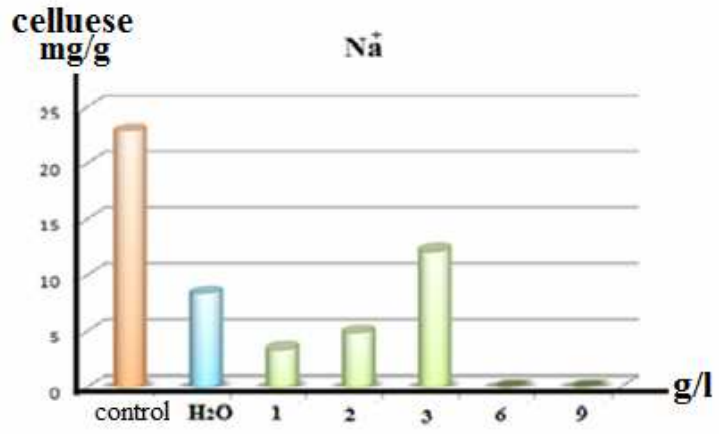
The two concentrations (6,9 g/l) had an inhibitory effect on the seeds growth.

Cellulose

When structural carbohydrates in maize seedlings were analyzed, figure and table (6) shows the results that have been obtained:

Table (6) effect of sodium ions on cellulose in seedlings,at gradual Concentrations

concentration	Control	H2O	Na^+				
			1	2	3	6	9
Cellulose mg/l	22.5	8.3	3.4	4.9	12.2	-	-
Disintegration		63.1	8.49	78.22	45. 8		



Figures (6) effect of sodium ions on cellulose in seedlings,at gradual Concentrations

The results show that when cellulose was calibrated, its concentration in seedlings grown in water medium for six days and incubated in sodium chloride medium at (1, 2, 3 g/l) concentration for 24 hours has decreased to 98.4%,78.22% ,36.2% for cellulose compared with control.

The Effect of Magnesium Ions on Carbohydrate Groups in Maize Seedlings

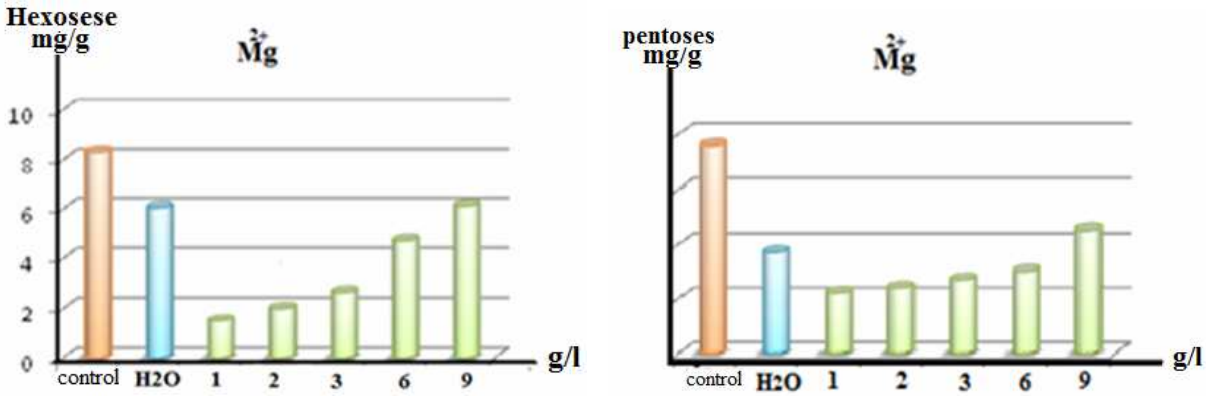
The effect of graded concentrations of the magnesium ion on the vital effectiveness was examined.

Dissolved Carbohydrates

Figures and table (7) show the results that have been obtained:

Table (7) effect of magnesium ions on Hexosese and Pintoses in seedlings,at gradual Concentrations

concentration	Control	H_2O	Mg				
			1	2	3	6	9
Hexosese mg/g	15.3	11.7	7.1	8.3	9.5	10.7	11.6
Disintegration		25.7	53	44	38	29	25.8
Pintoses mg/g	7.6	3.7	2.21	2.4	2.7	3	4.5
Disintegration		51	70	68	64	61	41



Figures (7) effect of magnesium ions on Hexosese and Pintoses in seedlings,at gradual Concentrations

The results show that hexoses concentration in seedlings grown in water medium for six days has decreased to 53%, but when the seedlings were incubated in magnesium ions medium, hexoses concentration in these seedlings cells decreased to 44%, 38%, 29% and 25.8% at (1, 2, 3, 6 g/l) concentration respectively compared with control .

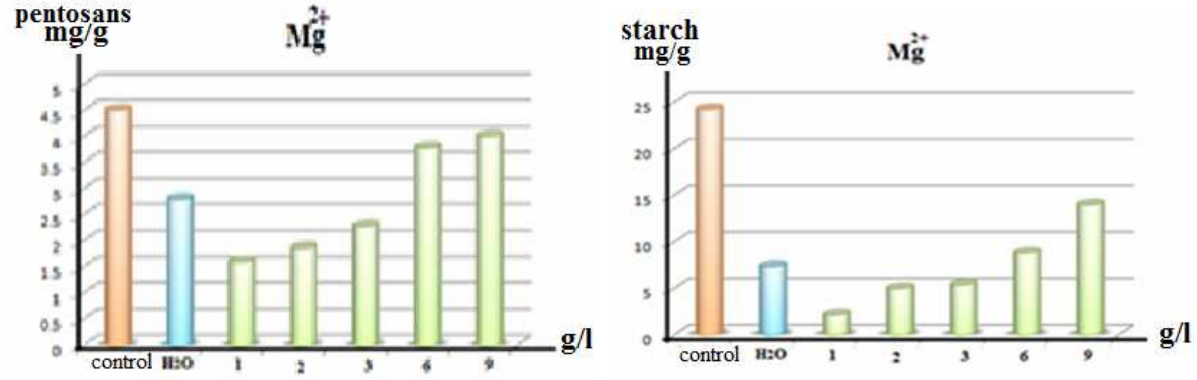
The same was applied to pintoses, and the results were similar to the results of hexoses calibration, Figure (7):

Easy Dissolved Carbohydrates and Hydrolysis

After calibrating glucose resulted from the disintegration of starch, figure and table (8) show the results that have been obtained.

Table (8) effect of magnesium ions on starch and pentosans in seedlings,at gradual Concentrations

concentration	Control	H_2O	Mg^{2+}				
			1	2	3	6	9
Hexosese mg/g	16.43	7.3	2.2	5	6.4	8.9	12.6
Disintegration		56	86.6	69.51	60.9	45.73	23.17
Pintoses mg/g	4.51	2.8	1.6	1.9	2.3	3.8	4.0
Disintegration		38	64.5	58.5	49.2	16	9.10



Figures (8) effect of magnesium ions on starch and pentosans in seedlings,at gradual Concentrations

The results indicate that starch and pentosans concentration in maize seedlinsg grown in water medium for six days has decreased to 56% for starch, and 38% for pintoses, but this reduction has increased when the seedlings were incubated in medium consisting of graded concentrations of magnesium ions, where starch concentration decreased to 86.6%, 69.51%, 60.9%, 45.73% and 23.17% and pentosans concentration decreased 64.5%, 58.4%, 49.2%, 16%, and 10.9 at (1, 2, 3, 6 ,9 g/l) concentrations respectively, compared with control.

Similarly, pentosans concentration has decreased gradually in incubated seedlings with the increase of magnesium ions concentration in the medium.

Cellulose:

Figure and table (9) shows the results of calibrating structural cellulose in maize seedlings grown in water for six days and incubated in magnesium ions medium at different concentrations.

Table (9) effect of magnesiume ions on cellulose in seedlings,at gradual Concentrations

concentration	Control	H_2O	Mg^{2+}				
			1	2	3	6	9
Cellulose mg/l	22.9	8.4	5.3	6.1	6.8	10	12.6
Disintegration		63.32	76.9	73.4	70.3	56.3	45

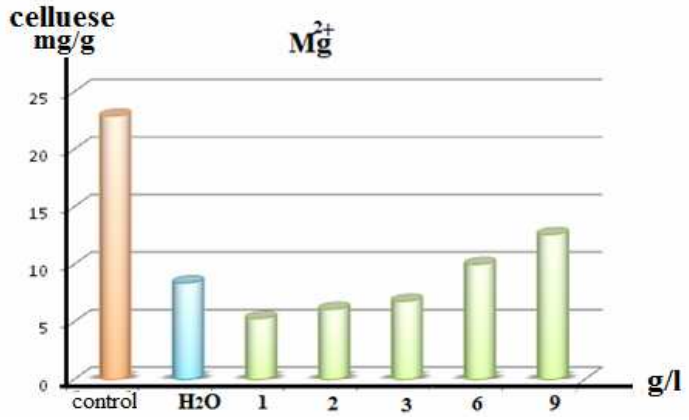


Figure (9) effect of magnesium ions on cellulose in seedlings, at gradual Concentrations

The results obtained indicate the disintegration of structural cellulose in seedlings grown in water medium for six days to 63.32%, this disintegration has reduced when the seedlings were incubated in different mediums of magnesium ions and the concentration of cellulose in seedlings cells has decreased with the increase of magnesium ions medium concentration compared with the seedlings incubated in water medium, as shown in figure (9) increasing the concentration of these ions in the medium, where the ratios of seedlings cellulose disintegration decreased to 76.9%, 73.4%, 70.3%, 56.3% and 45% at (1,2,3,6,9 g/l) concentration compared with the control.

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