

# Biochemical Studies on the Effect of Some Biofertilizers on the Chemical Constituents in Wheat Grains

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**Abstract:** A field experiment was conducted at Gazala Farm to study the effect of some biofertilizer; power max, citreen and Ectavol on the yield and some biochemical constituents in wheat grains. These results can be summarized as following; All treatments increased the grain yield of both varieties; Gimmaz-11 and sids-12; but using Ectavol treatment is more effective than those of other treatment. The foliar application of power max treatments gave the highest value of total nitrogen in wheat grains. The variation of proteins fractions; Globulin and Albumin' did not show clear trend especially in case of Gimmaza-10 cultivars. Power max treatments increased the content of amino acids, while, Citreen and Ectavol treatments decreased the most of amino acids. All treatments caused slightly increased the total soluble sugars of wheat grains. foliar application of Ectavol gave the highest increase of total carbohydrate and starch content of wheat grains. The highest increase of disaccharides (maltose and sucrose) resulted by citreen and Ectavol treatments. All treatment has a little decreasing effect on water adsorption dough development and stability time of dough in flour wheat grain. Phosphorus, potassium, calcium and magnesium were increased by foliar application of some biofertilizers. The highest increase of these elements resulted by Ectavol treatment.

**Keywords:** Wheat Grains , Biofertilizers , Ectavol, power max, citreen.

## 1. Introduction

Wheat is the most important cereal crop in Egypt, because of increasing human demand food attempts are made to cultivate more area with high yielding varieties in addition to using the recommended cultural practices to maximize the wheat productivity to meet the national needs. Biofertilizer are needed small quantities for normal plant growth and development and to proceed biological processes such as photosynthesis, respiration, synthesis of chlorophyll and stimulation of many enzymes. Inoculation wheat seeds with biofertilizer significantly increased the grain yield, 1000 grain weight rather than non-biofertilizer treatment [1]. Inoculation with any biofertilizer leads to considerable improvement in wheat grain and straw yield as compared with their respective control [2]. However response differed according to the type of biofertilizer. Its found that the complete foliar biofertilizer compound, Dogoplus caused significant stimulatory effect on growth parameters, in addition foliar spraying with 0.9% Dogoplus concentration gave the highest values chemical contents in yield and its components when compared with control [3]. bio fertilization treatments with and without four mineral significantly increased yield, protein content and NPK uptake of wheat grains. Also, bacteria inoculation significantly increased 1000 grain weight, grain yield, protein and Npk uptake compared with control [4]. On the other hand, Its found that a combination of organic and biofertilizer treatments increased chlorophyll, growth, carbohydrates and protein content compared with control [5]. The combinations of farmyard manure, vermicomposting and biofertilizer resulted in the highest increased growth yield of wheat over the control [6]. The presence of organic compost and biofertilizer positively affect wheat yield and its component [7]. Biofertilizer gave the highest values of biological yield,

1000 grain weight as well as grain and straw yield. Mineral nitrogen fertilization and biofertilizer inoculation on grain yield and protein content of wheat, who found that the yield and protein content of grains had a strong association with nitrogen fertilization and biofertilizer [8]. It is found that the wheat grains content from total sugars, total free amino acids, protein and total indols were increased due to the biofertilization treatments in both wheat cultivars [9]. In the present work an attempt is made to study the effect of foliar biofertilizer (power max, citrine and Ectavol) on yield, chemical contents of wheat grains and physical properties of the flour.

## 2. Materials and Methods

The field Experiment was conducted in the Agronomy farm of Ghazala, Zagazig, sharia Governorate 2014. A complete randomized block design was applied. Each treatment was replicated three times. The area of each plot was 3x2.5 m (11600feddan). Three varieties of wheat were used in this investigation; Gimmaza-10, Gimmaza-11 and sides-12, three foliar biofertilizers besides control were applied as follow:

- 1) control
- 2) power max; containing (2% amino acids, 3% riboflavin, 0.3% cytokine, 0.001% Gibberellic acids, 4.5% potassium citrate and 3.5% microelements and inner- ingredient (67.699%)
- 3) citreen; containing (15% organic acid, 2% iron grapple, 2% zinc grapple, 2% manganese grapple and publisher materials.
- 4) Ectavol; containing (20% nitrogen ,20% phosphorus, 20% potassium, 140 ppm zine 700 ppm ferrous, 420 ppm Manganese, 16 ppm copper, 140 ppm Molybdenum, 220 ppm Borne.

All foliar biofertilizer under investigation were applied at rate one litter in 100 litter water per Fadden. The foliar biofertilizer sprayed after 25 days from sowing data. At full maturity, the yield was determined and samples and stored until chemical analysis

- 1) Total nitrogen was determined following the kjeldahl methods as recorded in [10].
- 2) Soluble nitrogen was determined in the same samples according to the method described in[11].
- 3) Protein was fractionated into albumin, globulins, prolamins and glutelins according to the method described in[12].
- 4) Amino acids composition of seed protein was analyzed after hydrolysis with HCl (6N) according the method in [13].
- 5) Carbohydrate fractions were determined according to the method in[14].
- 6) Soluble sugars were determined according to the method in[15].
- 7) Physical properties of wheat flour were studied by using farinograph dough testing instrument. Farinograph recordings indicated, dough development, dough stability, dough consistency and the wreaking of the gluten, the methods used were those given by [16].
- 8) Phosphorus was determined in the acid digestion according to the method of Agize et al (1960)[17].
- 9) Ptoassium, calcium and magnesium contents of wheat grains were determined according to the method applied by [18].

### 3. Results and Discussions

The values representing yield of straw, grains and weight of 1000 grains of wheat are shown in Table(1). The date indicated a significant increase in grain yield of both varieties; Gimmaza-11 or sides-12 due to the applied of Ectavol treatment as compared with other treatments. In addition, it is worthy to mention that the highest grain yield was obtained in sides-12 variety by spraying all treatments. The least value of grain yield was observed in Gimmaza-10 varieties. In this connection, Hussin and Radwan (2001)[19] demonstrated the inoculated wheat seeds with biofertilizer significantly increased grain yield.

The obtained results indicated in Table (1) , show that, the straw yield followed nearly the same trend of grains. The highest straw yield was obtained in Gimmaza-11 varieties by foliar spraying of Ectavol treatments. These results are in full agreement with those obtained by [20-21]. Taking the weight of 1000 grains as parameter of quality, the treatment of Ectavol resulted the highest weight of 1000 grains in Gimmuza-11 variety as compared with control. These results are in agreement with those obtained by[22-23].

**Table 1:** Effect of biofertilizer on the yield of wheat

Verities	Treatmets	Yield (k. /plot)			Starch
		Grain	straw	Gr/st ratio	
<b>Gimmaza 10</b>	1-Contrl	4.250	4.693	0.905	45.13
	2- power max	4.688	4.585	1.022	46.03
	3- Citrine	3.848	3.906	0.985	44.56
	4-Ectavol	3.807	3.250	1.171	44.56

<b>Gimmaza 11</b>	1-Contrl	5.601	5.077	1.103	55.33
	2- power max	5.326	5.448	0.977	53.40
	3- Citrine	5.833	5.666	10.029	58.36
	4-Ectavol	6.788	6.497	1.044	61.83
<b>Sides 12</b>	1-Contrl	6.271	5.144	1.219	54.66
	2- power max	6.892	5.289	1.303	55.70
	3- Citrine	6.535	5.911	1.105	55.26
	4-Ectavol	7.149	5.780	1.236	58.60
LS.D					
	5%	0.465	0.486	-	2.415
	1%	0.422	0.537		2.466

The data presented in Table (2) indicated that the foliar application of power max treatments raised the values of total nitrogen in wheat grain of all varieties; Gimmaza-10.Gimmaza-11 and sides-12 as compared with control Also, it can be observed from the same table, spaying citreen and Ectavol treatment show a gradual increase in the soluble nitrogen fractions accompanied by a parallel decrease in the insoluble nitrogen fractions. This change was reflected on the sol. N / insol. N ratio which spraying the same treatments. This trend was observed with all varieties cultivars. Similar results were previously obtained by [24]. Also, from Table (2) indicates that the foliar application of power max treatments decrease the ratio between sol. N.I/ insol. N in wheat grains when compared with other treatments. This mean that the moderate rates of studied biofertilizers initiated nitrogen metabolism such results agree with those obtained by [25-26] .

**Table 2:** Effect of some biofertilizer on the nitrogen fractions on wheat grains (gm/ 100gm).

Varieties	Treatments	Soluble nitrogen	Unsalabe nitrogen	Total nitrogen	Sol./ insol ration
Gimmaza10	1-control	0.364	1.624	1.988	0.224
	2-power max	0.0319	1.745	2.064	0.183
	3-citreen	0.375	1.604	1.979	0.234
	4-Ectavol	0.386	1.616	2.002	0.239
Gimmaza11	1-control	0.336	1.806	2.142	0.186
	2-power max	0.321	1.885	2.206	0.170
	3-citreen	0.364	1.738	2.102	0.209
	4-Ectavol	0.386	1.738	2.124	0.222
Sides 12	1-control	0.347	1.844	2.191	0.188
	2-power max	0.326	1.895	2.221	0.172
	3-citreen	0.360	1.831	2.191	0.196
	4-Ectavol	0.372	1.836	2.208	0.202

Data in Table(3) show the results of foliar biofertilizer on the contents of protein fractions; albumins globulins, prolamins and glutelins. The variations in the albumins and globulins did not show clear trends especially in case of Gimmaza-10 varieties. For Gimmaza-11 and sides-12 there were slight increases in albumin accompanied by decreases in globulins fractions. prolamin fractions has shown pronounced increases caused by power max and citrine treatments regardless of the cultivar. The effect of all treatments on glutelins content was clear and common for their studied cultivars. All biofertilizers had caused considerable reductions in the glutelins level. Hence, it can be concluded that, biofertilizer treatments might inhibit some steps in the biosynthesis of gluten fraction.

**Table 3:** Effect of some biofertilizer on the relative/percentage of protein fractions of wheat grains

varieties	Treatments	Protein soluble fractions					Insoluble protein
		Albumins	Globulins	prolamins	Glutelins	Total	
Gimmaza10	1-control	15.02	18.66	1.42	18.40	53.50	46.46
	2-power max	17.28	22.44	2.65	10.39	52.76	47.24
	3-citreen	14.11	15.78	3.28	9.88	43.05	56.95
	4-Ectavol	15.28	13.85	1.22	8.26	38.61	61.39
Gimma11	1-control	13.46	16.67	1.35	17.52	49.00	51.00
	2-power max	16.24	15.11	3.11	10.65	45.11	54.89
	3-citreen	16.85	12.82	4.22	8.96	42.85	57.10
	4-Ectavol	17.16	10.68	1.16	7.82	36.82	63.18
Sides12	1-control	14.28	17.75	1.44	16.45	49.92	50.08
	2-power max	16.16	20.85	3.66	13.82	54.49	45.51
	3-citreen	16.85	16.82	4.54	12.22	50.43	49.56
	4-Ectavol	17.88	14.75	1.25	11.84	45.52	54.48

Data presented in table (4) illustrated that, the amino acids content of wheat grains were affected by some biofertilizers; power max, Citreen and Ectavol. It can be seen that power max treatments generally increased the content of amino acids, except that the Sulphur amino acids which slightly decreased. On the other hand, spraying of wheat plants with citrine and Ectavol treatments decrease the most of amino acids. Also, it can be easily seen from the same table, aliphatic amino acids were increased by foliar application of power max treatments, but in this group alanine represented

comparatively the highest amount. In acidic amino acids group, it can be noticed that, aspartic acid and glutamic amino acids were decreased by spraying of Ectavol treatments. Also, from the same Table, the results showed that all treatments decreased the Sulphur amino acids. In addition, the difference in the amino acids in wheat grains as affected by biofertilizer treatments seems to be trivial within every cultivar. Generally, it can be noticed that all

**Table 4:** Effect of some biofertilizer on the content of amino acids in wheat grains (gm/100gm).

varities	treatments	Aliphatic A.A				Acidic A.A			Basic A.A			Aromatic A.A			Hetero A.A			Sulphur A.A		
		Glycine	Alanine	Valine	total	Aspartic	Glutamic	Total	lysine	Arginine	pTotal	Tyrosine	Phenyl alanine	Total	proline	HHistidine	TTTotal	Methionine	cystein	Total
Gimmaza 10	1-control	2.27	2.61	1.07	5.95	3.75	5.96	9.71	2.17	3.43	5.06	1.99	3.91	5.90	1.71	1.83	3.54	1.61	1.47	2.68
	2-power max	2.53	2.71	1.61	6.85	3.97	6.28	10.25	2.31	3.51	5.82	1.53	4.07	5.60	1.77	2.19	3.94	1.49	1.03	2.52
	3-citreen	2.11	2.01	1.40	5.52	3.91	5.96	9.87	2.39	3.43	5.82	1.59	4.00	5.59	1.69	1.83	3.52	1.54	1.00	2.54
	4-Ectavol	1.73	2.07	1.29	5.09	3.51	5.69	9.20	2.29	2.97	5.20	1.41	3.81	5.22	1.53	1.99	3.52	1.40	0.94	2.34
Gimmaza 11	1-control	2.42	2.76	1.62	6.80	3.88	6.12	10.00	2.32	3.58	5.90	2.04	4.06	6.10	1.86	1.44	3.85	1.76	1.22	2.98
	2-power max	2.68	2.86	1.76	7.30	4.12	6.43	10.55	2.46	3.66	6.12	1.68	4.22	5.90	1.92	2.22	4.14	1.64	1.18	2.82
	3-citreen	2.26	2.56	1.55	6.35	4.06	6.11	10.17	2.54	3.58	6.12	1.74	4.15	5.84	1.74	1.98	3.72	1.86	1.18	2.86
	4-Ectavol	1.88	2.22	1.44	5.54	3.65	5.84	9.49	2.44	4.02	6.46	1.56	3.96	5.52	1.68	2.04	3.72	1.55	1.09	2.64
Sides 12	1-control	2.28	2.68	1.78	6.54	3.52	5.72	9.24	2.35	3.66	6.01	1.74	4.06	5.80	2.02	1.86	3.39	1.67	1.32	2.99
	2-power max	2.58	3.01	1.84	7.43	3.78	5.94	9.72	2.44	3.82	6.26	1.85	4.24	6.09	1.98	1.76	3.74	1.64	1.18	2.82
	3-citreen	2.42	2.84	1.65	6.91	3.74	5.55	9.29	2.18	3.82	6.00	1.88	3.96	5.84	1.74	1.68	3.42	1.58	1.14	2.72
	4-Ectavol	2.64	3.01	1.78	7.43	3.88	5.72	9.60	2.22	4.19	6.41	1.48	4.15	5.63	2.08	1.76	3.84	1.64	1.14	2.78

Treatments improved the contents of some amino acids which are important in some bioprocess. This increase may be due to the increase in amino acyl transfer RNA synthesis and to the increase in content and activity of enzymes. These results are in agreement with those stated by [27], who found that, wheat grains content from total amino acids, protein and total indoles were increased due to the biofertilizer treatments in all wheat cultivar

It can be observed in table(5) that there was a decreasing effect of biofertilizer treatments on the reducing sugars a decreasing wheat grains met by a parallel increasing effect on the non-reducing sugars. This may lead to a conclusion that biofertilizer might have affected the synthesis of the

oligosaccharides. The total soluble sugar content was also increased by biofertilizer treatment revealing that the decrease in the reducing sugars content, because of biofertilizer inhibitory effect on the synthesis of the monosaccharide's, but stimulating effect on oligosaccharides synthesis.

**Table 5:** Effect of some biofertilizer on the content of carbohydrate fractions of wheat grains (gm/100gm).

Verities	Treatmens	Sugars fractions			Carbohydrates		Starch
		R.S	N.R.S	T.S	Insoluble	Total	
Gimmaza	1-Contrl	1.25	1.72	2.97	58.65	61.82	51.75

10	2- power max	1.10	2.08	3.18	59.50	62.68	52.55
	3- Citrine	1.08	2.17	3.25	60.03	63.28	53.42
	4-Ectavol	1.04	2.28	3.32	60.66	63.98	55.11
Gimmaza 11	1-Contrl	1.32	1.82	3.14	58.80	61.94	52.13
	2- power max	1.21	2.12	3.33	58.65	61.98	52.64
	3- Citrine	1.11	2.06	3.17	60.51	63.68	53.43
	4-Ectavol	1.18	2.16	3.34	60.78	64.12	55.82
Sides 12	1-Contrl	1.28	1.89	3.17	58.71	61.88	52.26
	2- power max	1.16	2.03	3.19	58.47	61.66	52.82
	3- Citrine	1.10	2.11	3.21	60.33	63.54	53.18
	4-Ectavol	1.08	2.18	3.26	60.88	64.14	53.92

A similar effect might be concluded for biofertilizer on the synthesis of polysaccharides since there were generally pronounced increase in the insoluble carbohydrates and starch content of wheat grains of plants treated with biofertilizer regards of the cultivars. These increase resulted in enhancing the total carbohydrates content of wheat grains. Comparing the three cultivars shows that, all variety of wheat were at the same highly responsive level. Also, from

the same table showed that spraying of Ectavol treatments induced the highest increase in total carbohydrate and starch content, while the power max treatments caused a reducing effect when compared with other treatments. The biofertilizers favorable effect on the synthesis of polysaccharides was previously reported on the other plants [28], who found that a combination of organic and biofertilizer treatments increased chlorophyll, growth, carbohydrates content compared with control.

The chemical analysis of grains showed the presence of four sugars as shown in table (6). The percentage of disaccharides relatively increased by spraying all treatment and the highest increase of disaccharides resulted by Citreen and Ectavol treatments. Whereas the lowest values recorded by spraying power max treatments. On the other hand the percentage of monosaccharides relatively decreased by adding of all biofertilizer treatments and the highest decrease of monosaccharides resulted by citrine treatments, the positive effect of biofertilizer treatments on sugars were previously reported [29], who found that, wheat grains content from total sugars were increased due to biofertilizer treatments in both wheat grains.

**Table 6:** Effect of some biofertilizer on the percentage of free sugars in wheat grains.

varieties	Treatmnts	Mono saccharides			Disaccharides			Mon / Di ratio
		Glucose	fructose	Total	Maltose	sucrose	Total	
Gimmaza10	1-control	0.085	0.145	0.230	1.110	0.190	1.300	0.177
	2-power max	0.072	0.135	0.207	1.140	0.190	1.337	0.155
	3-citreen	0.075	0.130	0.205	1.160	0.240	1.400	0.146
	4-Ectavol	0.075	0.136	0.211	1.215	0.210	1.425	0.148
Gimmaza11	1-control	0.075	0.139	0.214	1.120	0.195	1.315	0.163
	2-power max	0.075	0.135	0.210	1.235	0.205	1.440	0.146
	3-citreen	0.064	0.135	0.199	1.300	0.214	1.514	0.131
	4-Ectavol	0.064	0.130	0.194	1.250	0.205	1.455	0.133
Sides 12	1-control	0.080	0.142	0.222	1.125	0.195	1.320	0.168
	2-power max	0.075	0.135	0.210	1.310	0.186	1.496	0.140
	3-citreen	0.070	0.138	0.208	1.325	0.195	1.520	0.137
	4-Ectavol	0.079	0.135	0.210	1.300	0.190	1.490	0.141

Ferino-graph data presented in Table (7) show some Physical properties namely, the adsorption percentage of dough consistency, dough development, dough stability and weakening of the gluten. It can be clear that all treatments have a little decreasing effect on the water adsorption percentage, the dough development and the stability time of dough as compared with control. Also, it can be noticed the power

max treatment increased the weakening of gluten (B.u), but spraying Ectavol treatments slightly decrease the weakening of gluten as compared with control. These results are nearly similar to the previous results obtained when used all cultivars of wheat grains.

**Table 7:** Effect of some biofertilizer on some physical properties of wheat flour

Varieties	Treatments	Adsorption%	Time of dough development	Dough of stability time(Min)	Weaking of gluten(B.u)
Gimmaza10	1-control	66.8	3.00	2.25	125
	2-power max	66.2	2.50	2.00	130
	3-citreen	66.0	2.00	1.50	120
	4-Ectavol	66.2	2.25	1.25	120
Gimmaza11	1-control	65.4	3.25	2.50	130
	2-power max	65.0	2.75	2.00	135
	3-citreen	65.2	2.25	1.50	130
	4-Ectavol	65.4	2.50	2.00	120
Sides 12	1-control	65.8	3.25	2.50	120
	2-power max	65.4	3.25	2.25	135
	3-citreen	65.0	2.50	2.25	125
	4-Ectavol	65.0	2.75	2.00	125



Data in Table (8) show the percentage of P, K, Ca, and Mg in wheat grains. The all minerals percentage of wheat grains were increased by all treatments and the increase was greater

in Ectavol treatment than other treatments. These results are in agreement with those obtained by [30].

**Table 8:** Effect of some biofertilizer on the content of P, K, Ca and Mg of wheat grains.(gm/100gm).

Varieties	Treatments	phosphorus	potassium	calcium	Magnesium
Gimmaza10	1-control	0.56	1.58	0.84	0.51
	2-power max	0.59	1.62	0.84	0.55
	3-citreen	0.59	1.64	0.82	0.52
	4-Ectavol	0.62	1.71	0.86	0.57
Gimmaza11	1-control	0.55	1.54	0.83	0.50
	2-power max	0.58	1.58	0.84	0.52
	3-citreen	0.55	1.62	0.86	0.54
	4-Ectavol	0.60	1.72	0.86	0.57
Sides 12	1-control	0.58	1.59	0.84	0.53
	2-power max	0.59	1.61	0.85	0.53
	3-citreen	0.61	1.61	0.87	0.55
	4-Ectavol	0.64	1.78	0.88	0.57

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