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EFFECT OF *FABA BEAN* SEED SPROUTING USING SALINE WATER ON ITS ANTIOXIDANT PROPERTIES

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ABSTRACT

Legumes play a fundamental role in human nutrition in many countries. Germination is considered as one of the most effective processes to improve the quality of legumes. Faba bean seeds have been chosen for this study, to do a comparative study on the chemical analysis and phytochemical contents of the faba bean seeds and their germinated samples using tap and saline water was studied. The antioxidant activity (total antioxidants, phenols and flavonoids) comparison of the seed and the selected sprouted samples was, also, extended.

Vitamins, phenols, total flavonoids and other important compounds, that might be considered beneficial as antioxidants, often dramatically change during the course of germination. The obtained data of the current study revealed, through measuring sprout characters, that 1000 ppm NaCl was the appropriate concentration with respect to performance of the sprouting of Faba bean.

It was, also, found that there was a slight increasing in protein, amino-acids and some minerals in tap and saline water sprouted samples. A marked increasing in antioxidant activity, total phenols and total flavonoids in tap water and saline water sprouts was also detected. It could be concluded that germination process increases the nutritive value of the seeds and is a good way to enhance the antioxidant properties of legume seeds. Consequently, germination process could be used as a source of natural antioxidants in functional foods and could be considered as an important step towards the future evolvement of value-added foods and which can be used in the development of novel food products with beneficial effects on human's health.

Keywords: Sprouting; Saline water; Characteristics of faba bean seeds

INTRODUCTION

Legumes are one of the most essential sources of food in the world. Cooking is usually done before using of legumes in human diet. This improves the protein quality by destruction or inactivation of the heat-labile antinutritional factors. However, cooking causes losses in soluble solids, especially vitamins and minerals. Increasing the time and temperature of processing has been reported to reduce the nutritive values and available lysine of legumes **(Vijayakumari et al 1998)**. However, antinutritional factors limit the food applications of legumes. Germination, also, enhances the nutritive value of legumes by inducing the formation of enzymes that eliminate or reduce the antinutritional and indigestible factors in legumes **(Bau et al 1997).**

Some biotechnological processes and methods such as germination are considered simple and economical to improve the nutritive values of legumes by causing desirable change in the nutrient availability, texture and organoleptic characteristics. Extended breakdown of seed-storage compounds and synthesis of structural proteins and other cell components occur during the germination. Secondary compounds and many of which are considered beneficial as antioxidants, often dramatically change during the germination **(Kuo et al 2004).** It is known that the germination

process mostly improves the nutritional quality of legumes, not only by the reduction of anti-nutritive compounds but, also, by increasing the levels of free amino acids, available carbohydrates, dietary fiber and other components, as well as increasing the functionality of the seeds due to the dependent increase in the bioactive compounds **(Lopez-Amoros et al 2006).**

Food legumes have been playing very fundamental role in the human diet for a long time. In recent years, consumer interest in healthy food has increased. Dieticians recommend utilization of legume plants as a worthy source of proteins, vitamins, minerals and various bioactive components. Increasing popular additions to dishes such as sprouts plants, including adzuki beans, are spreading from Far East. The sprouts are excellent examples of 'functional foods' defined as an agent to lower the risk of various diseases **(Randhir et al 2004)**. Legume sprouts are rich in amino acids, macro and microelements and a variety of vitamins. They are recommended for people with ailments of the pancreas and kidneys. The valuable effects are especially attributed to phytochemicals such as phenolic compounds. During the germination of seeds, nutrients under influence of moisture, temperature, and primarily enzymes action are transformed into compounds facilely and quickly absorbed by the body. The raise content of bioactive compounds causes that consumption of sprouts strengthens body's immunity **(Li et al 2011).**

Bioactive compounds and antioxidant activity of germinated mung bean and soybean sprouts were investigated by **(Xue et al 2016)** to find out the effect of germination and the optimum germination time. They found vitamin C gradually increased from zero. Compared to seeds, water soluble protein and total flavonoid content showed a trend of sustained growth.

Faba bean sprouts contain more polyphenol than the bean itself. Antioxidant screening program has shown that fava bean sprouts also possess a higher antioxidant activity than other commercially available sprouts and mature beans. They could therefore be useful in the diet as an attractive and palatable source of antioxidants to help maintain human health **(Okumura et al 2016).**

The objectives of this study were first to estimate the effect of different concentration of saline water (NaCl) Comparing with Tap water on Faba been seeds germination. Second, compare the chemical analysis and phytochemical contents of the selected dry seeds and their germinated samples. Beside to, compare the antioxidant activity (as well as the phenols and flavonoids contents) of the selected sprouted samples.

MATERIALS AND METHODS

The current study was carried out at Horticulture Department, Faculty of Agriculture, Ain Shams University, Cairo and the Regional Center for Food and Feed (RCFF), Agricultural Research Center (ARC), Giza with in the 2016-2017 season.

Faba bean seeds (Sakha 4 variety) were was obtained from the Crop Institute, Agricultural Research Centre, Giza, Egypt. 50 gram of beans were weighted after washing and the bad seeds were excluded, then were put eed in a plastic jar with 300 ml of Tap water as a control sample.

Different concentrations (1000, 2000, 3000, 4000 ppm) of saline water (NaCl) for 18 hr were used as a soaking media in the tested samples instead of top water in the control sample. The get rid of socking water and wash them every 8 hr. All samples were left to germinated up to 2 days.

The sprouted seeds were collected for measuring sprout characters after 2 Days. According to the best results of measuring characters, the tested samples were samples were ground in the laboratory by a miller mill and the grounded seeds wer stored at 5°±1ºC until analysis and except for vitamins determination where it must be done on fresh samples.

The data were statistically analyzed by analysis of variance using completely randomized design and least significant difference (LSD) at 0.05 levels according to the method described by **(Snedecor and Cochran, 1980)**.

Chemical analysis

Proximate analysis

Total crude protein, fats, fiber, moisture, and ash were analyzed according to **(AOAC 2012)**. Total carbohydrates were determined by differences **(Chinma & Lgyor, 2007)**.

Minerals determination

All mineral: Iron, Magnesium, Copper, Zinc, Selenium, Sodium, Potassium, Manganese, Calcium and phosphorus were analyzed by ICP optima 2000 DV Perkin Elmer according to the method described in the **(AOAC 2012)**.

Amino acids analysis

Amino acids determination was performed according to **(AOAC 2012).** The instrument used for analysis was Eppendorf LC 3000.EZ Chrom.

Determination of vitamins C, A, E contents

All samples were analyzed according to Ministry of Health Institute of food Chemistry and Nutriton Danish official. **(AOAC, 2012)**.

Determination of total antioxidant activity

The antioxidant activity was expressed as ascorbic acid. The absorbance of samples was measured at 695 nm using a spectrophotometer according to the procedure described by **(Prieto et al 1999).** All tests were performed in triplicate and means were calculated.

Phytochemical constituents

Samples were extracted using anhydrous ethyl alchol according to **(Santana et al 2013)**. 1 μL of sub sequent filtrate was injected into GC/MS for analysis.(Agilent 7000 Triple quad)

The analysis was carried out using a GC (Agilent Technologies 7890A) interfaced with a mass-selective detector (MSD, Agilent 7000 Triple Quad) equipped with Agilent HP-5ms capillary column. The carrier gas was helium with the linear velocity of 1 ml/min. The injector and detector temperatures were 200ºC and 250ºC, respectively. Volume injected 1µl of the sample. The MS operating parameters were as follows: ionization potential 70 eV, interface temperature 250º C, and acquisition mass range 50–600.

RESULTS AND DISCUSSION

Effect of NaCl concentrations on sprouting characters of Faba bean seeds

Table (1) showed Faba bean sprouts (2 days old etiolated) length, fresh and raw seeds. Mean of sprout length varied between 0.79 and 1.09 cm at various NaCl concentrations. The longest length was observed in the control and in 1000 ppm NaCl.

The same Table showed that by increasing NaCl concentration, sprout length decreased to 80, 79 and 67% at 2000, 3000 and 4000 ppm NaCl, respectively with no significant decrement at 1000 ppm NaCl compared with control.

Fresh and dry weight in Fba bean sprouts gave the highest value and had no significant in 1000 ppm NaCl concentrations, in case of fresh weight, compared with control (tap water). These result reveres that 1000 ppm NaCl is the appropriate concentration for performance the sprouting of *Faba bean* and was select for making the chemical analysis and phytochemical Contents estimation.

Proximate analysis result

Table (2) show the results of proximate analysis of Faba bean seeds and its sprout using tap water, saline water (1000 ppm NaCl).The protein content of *Faba bean* ranged from 20 to 41%, values which depend on the variety. Faba bean seeds contain 51% to 68% of carbohydrate in total, the major proportion of which is constituted by starch (41–53%).

It was found that there was not any noticable change in proximate analysis results except for protein which has shown an increasing in sprouts samples in both treatments tap and saline water. Assuming that increasing was due to synthesis of enzyme proteins activities (for example, proteases) by germinating or a compositional change following the degradation of other constituents as imposed by **(Bau et al 1997)**, **(Nonogaki et al 2010)**.Where it was noted that, protein synthesis occurred during imbibition and that hormonal changes play an essential important role in achieving the completion of germination.

Minerals results

Minerals contents in samples are shown in **Table (3)**. There was some increasing in Ca, P, Mg and Zn contents in tap and saline water sprouts. Samples compared with the raw seeds. Na content was highly increased especially in saline water sprouts which attributed to the NaCl concentration in the saline solution used for rinsing seeds during germination. This increasing in these elements was observed too in a study on green radish sprouts **(Tahany, 2015).** While Fe content was decreasing by sprouting as shown by **(Yuwei and Weihua, 2014).**

Amino acids analysis

Effect of sprouting the Faba bean seeds using tap water and saline water on Amino acids is shown in **Table (4)**. Whereas there are well-balanced between protein and amino acids, then slightly increase was found in the relative contents of both essential and non-essential amino acids

Table 1. Effect of different concentrations of NaCl on 2 days old etiolated Faba bean sprouts characters

Conc. of NaCl	Sprout Length (cm)	Sprout dry weight (gm)	Sprout fresh weight (gm)
Tap water (control)	1.18[a]	0.7529[c]	1.6840[a]
1000	1.09[ab]	0.8177[b]	1.6988[a]
2000	0.95[bc]	0.8160[a]	1.6693[a]
3000	0.94[bc]	0.7886[a]	1.5553[b]
4000	0.79[c]	0.7789[bc]	1.4738[b]
LSD at 0.05	0.19723	0.0271	0.1020

Table 2. Effect of sprouting of Faba bean seeds by tap and saline water on proximate analysis (as % on wet Basis of dry weight)

Analysis	Sprouting faba bean		
	Raw Seed	With tap water	With saline water
Crude protein	21.30	23.50	25.00
Fiber	8.00	8.75	7.97
Ash	3.15	3.02	3.07
Moisture	6.96	7.21	6.72
Fats	1.54	1.58	1.6
Carbohydrates	59.05	55.94	55.64

Table 3. Effect of Faba bean sprouting on minerals analysis (as % on wet Basis of dry weight)

Minerals (ppm)	Sprouting Faba bean		
	Raw Seed	With tap water	With saline water
Ca	972.1	1290	1201
p	4665	4978	5187
Cu	13.49	15.34	13.79
Fe	55.25	41.34	42.60
Mg	1400	1537	1430
Mn	10.22	11.95	10.06
Zn	25.63	32.37	32.42
Se	2.750	3.415	2.761
Na	317.1	435.5	2510
K	9987	9236	9146

Table 4. Effect of sprouting the Faba bean seeds using tap water and saline water (NaCl 1000ppm) on Amino acidscompared with dry seeds (g /100g dry weight Protein)

Amino acid	Raw Seed	Tap water	Saline water
Aspartic acid	10.89	9.32	9.56
Therionine	3.75	3.02	0.76
Serine	5.02	4.47	2.84
Glutamic acid	18.31	16.71	3.88
Glycine	4.18	3.32	14.80
Alanine	4.51	3.79	3.36
Valine	5.12	4.55	4.04
Isoleucine	4.22	3.70	4.16
Leucine	7.28	6.25	3.72
Tyrosin	3.90	3.45	6.20
Phenylalanine	4.69	4.00	3.44
Histidine	2.96	2.55	3.84
Lysine	6.95	6.08	2.40
Arginine	9.86	8.13	5.60
Proline	4.27	3.49	7.44
Cysteine	1.55	1.96	1.20
Methionine	1.08	0.98	0.72

by germination process either by tap or saline water. Such observation was also reported by **(Mostafa et al 1987)** in their study on germination of soybean.

Chen and Thacke (1978) reported that during germination there is probably a turnover of proeins and amino acids With the balance between synhetic and dervative processes detemining the resultant pattern. The changes in amino acids content (increment insome and decrement in others) can be atttibuted to the release of amino groups from decrement amino acids to oxaloacetate in the shft from atorage protein to functional protein during the course of sprouring as reported before by **(Dagnia et al 1992).** Certain amino acids may be readily broken down than others and this is another potenial source of alternations in the protein pattern during germination **(Rodriguez et al 2008).**

Antioxidant activity, total phenols, total flavonoids and vitamins results of sprouting Faba bean were shown in **Table (5)**. It was observed that sprouting showed an increasing in antioxidant activity total phenols and total flavonoids in both tap and saline water sprouted samples which imply that the ability of the components in sprouts (antioxidants) to scavenge free radicals increases after the germination process.

From **Table (5)** it is valuable to mention that vitamins E and C have increased in both tap and espicaly saline water. This is consistent with **(Kavas and Nehir (1992)**, who noticed that germination significantly increased the content of ascorbic acid of the white beans, black beans and pigeon beans. Whereas the ascorbic acid increment in soybeans Brag variety germinated for four days was 90% **(Ahmad and Pathak, 2000).** Therefore, the germinated legume seeds can be considered premium source of ascorbic acid.

This reverses that sprouts of Faba bean either from tap water or saline water are valuable source of antioxidants which can be used in the development of innovative food products.

Table 5. Effect of sprouting Faba bean on Antioxidant Activity, total phenols, total flavonoids and vitamins compared with raw seeds.

Analysis	Sprouting faba bean		
	Raw Seeds	Tap water	Saline water (NaCl)
Activity Antioxidant mg\100g	303.88	315.44	379.38
total phenols (ppm)	1717	2332.5	2387
total flavonoids ppm)	17.10	275.10	244.8
Vitamin A(IU)	ND	ND	ND
Vitamin E (IU)	0.28	0.36	0.95
Vitamin C (mg/100mg)	0.0027	0.0034	0.0055

Phytochemical screening of Faba bean seed and sprouts

The obtained Chromatogram for phytochemical screening compounds of Faba bean seed are shown in **Fig. (1)** and the chromatogram for phytochemical compounds of Faba bean sprouts using tap water and saline water are shown in **Figs. (2 & 3)** respectively. Its whole recognized compounds are tabled in **Table (6)**. It seems from the results in **Table (6)** that germination has a positive effect to present some phyto-compounds which weren't exist in the seed. Some of these compounds are phenols like as methyl 4-hydroxybenzoate, syringic acid and resorcinol. Others are terpienes like as: α-Pinene, γ-Terpinene, 4-Terpinenyl acetate, Geraniol, p-Cymen-7-ol and nopol. All these compounds were exist as a results of Faba bean germination.

Some compounds have been appeared in tap water sprouts and increased in saline water sprouts. Some of these compounds are phenols which has antioxidant activity as: homovanillic acid, 2,5-dihydroxybenzoic acid, 4-hydroxy-2-methoxybenzaldehyde, allo-Ocimene and vanylglycol. Other compounds are flavonoids which also has antioxidant activity as o-Cresol, α,α'-(propylenedinitrilo)di and Isoorientin.

Noteworthy that there were some compounds which appeared only in saline water sprouts owing to NaCl concentration. Some of these compounds are phenols as salicylic acid, cineole, 2-methoxy-5-nitrophenol, methyl vanillate, levallorphan and propyl gallate. Others are terpienes as: mentha-2,8-dien-1-ol, para, cis, β-terpinen, terpinen-4-ol, isopulegol, 3-bornanol, α-terpinyl propionate, endo-borneol, L-α-terpineol, chamigrene, α-guaiene andα-cedrene.

It seems as shown by **(Zoltek et al 2015)** in their study on adzuki bean that sprouting reduces anti-nutritional factor and increases the bioavailability of macro, micronutrients and also affects phytochemical levels.

From the previous results it is cleared that germination has shown an increasing in the micronutrient, phyto-nutrient content of faba bean seeds, thus proving that there is clear increasing in the nutritive value of the seeds on sprouting.

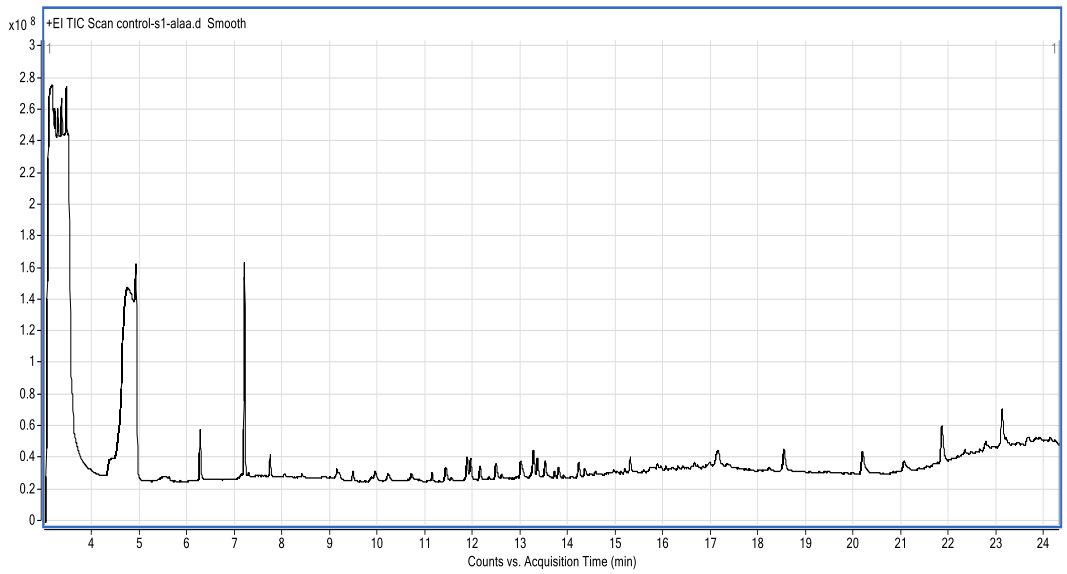

Fig. 1. GC/MS Chromatograph of seeds of Faba bean

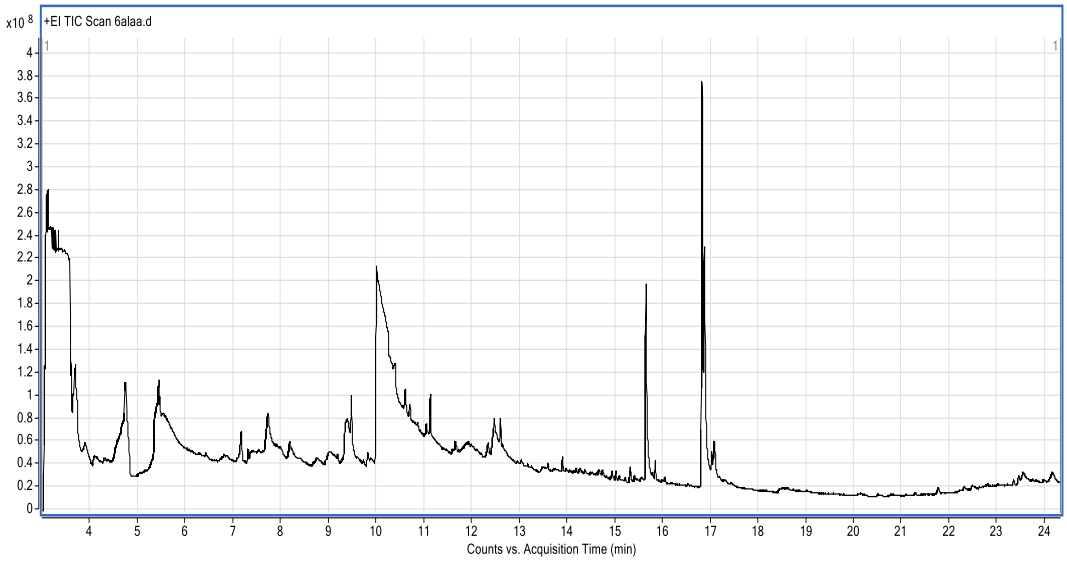

Fig. 2. GC/MS Chromatograph of sprouts Faba bean with tap water

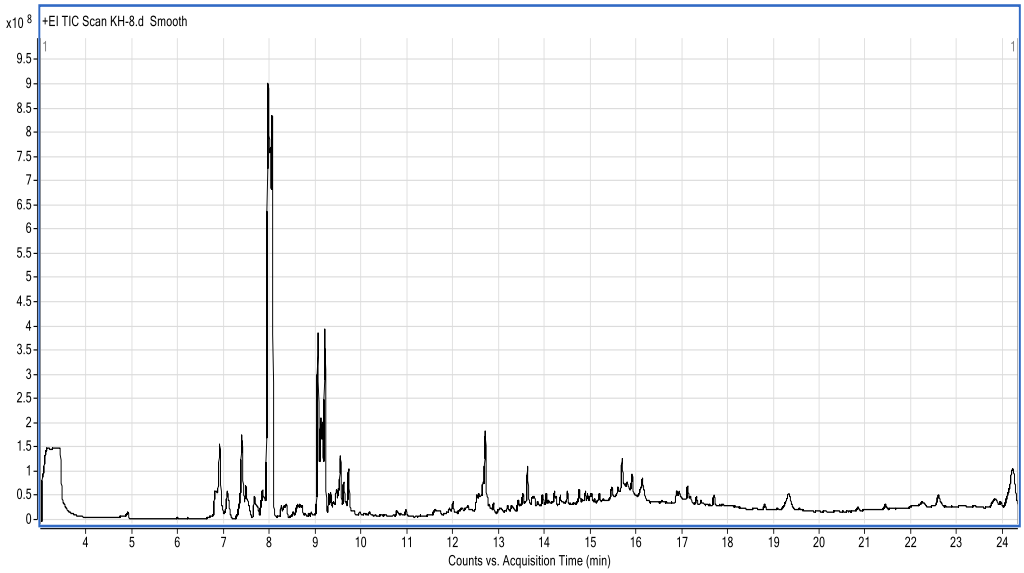

Fig. 3. GC/MS Chromatograph of sprouts Faba bean with saline water

Table 6. Phytochemical compounds identified in the ethanolic extract fractionation of Faba sprouts and seeds

No	RT	Compound	Raw seeds	Tap water	Saline water
1	3.070	Pivalic acid	10.9	4.81	0.31
2	3.247	Sabinene	20.72	11.09	5.18
3	4.517	4-Methoxycinnamic acid	20.17	----	0.16
4	4.853	Sinapyl alcohol	2.96	4.07	0.26
5	5.406	dl-Allo-cystathionine	0.70	4.09	0.21
6	6.200	Mentha-2,8-dien-1-ol, para, cis-	-----	------	0.15
7	6.493	Salicylic acid	----	-----	0.17
8	6.673	Esculetin	---	0.75	0.21
9	6.814	α-Pinene	---	0.48	1.04
10	6.909	γ-Terpinene	----	0.73	2.66
11	7.187	α-Bisabolol	2.56	-----	1.08
12	7.303	Homovanillic acid	----	0.71	2.72
13	7.367	4-Terpinenyl acetate	----	1.19	0.83
14	7.413	β-Terpinen	----	----	1.18
15	7.730	4',6-Dimethoxyaurone, trans-	0.33	1.69	0.28
16	7.877	Cineole	----	----	0.34
17	7.947	Terpinen-4-ol	-----	----	14.6
18	8.048	Isopulegol	-----	----	9.35
19	8.057	3-Bornanol	---	----	1.14

Table 6. Cont.

No	RT	Compound	Raw seeds	Tap water	Saline water
20	8.180	o-Cresol, α,α'-(propylenedinitrilo)di-	----	0.73	1.1
21	8.637	allo-Ocimene	-----	1.29	4.77
22	9.086	2,5-Dihydroxybenzoic acid	----	0.81	2.19
23	9.111	2-Methoxy-5-nitrophenol	-----	----	4.37
24	9.144	4-Hydroxy-2-methoxybenzaldehyde	-----	0.39	1.61
25	9.129	Methyl vanillate	----	----	0.43
26	9.199	Geraniol	---	0.51	0.7
27	9.291	α-Terpinyl propionate	----	---	2.36
28	9.364	endo-Borneol	---	----	0.83
29	9.471	Gentisic acid	0.56	1.17	1.05
30	9.575	L-α-Terpineol	-----	-----	0.65
31	9.715	Methyl 4-hydroxybenzoate	----	1.36	0.27
32	10.238	α-Himachalene	0.63	21.73	0.45
33	10.775	p-Cymen-7-ol	---	1.93	0.87
34	11.126	Phloroglucinol	0.47	1.07	0.6
35	11.429	Mandelic acid, 3,4-dihydroxy	0.32	-----	0.44
36	11.869	Caryophyllene	1.06	1.89	0.45
37	11.997	Chamigrene	----	----	0.29
38	12.156	Cumaldehyde	0.45	----	0.92
39	12.300	Hexa-hydro-farnesol	0.55	0.45	3.22
40	12.486	Longipinene	0.40	0.93	0.83
41	12.608	Benzoic acid, 4-amino	0.57	1.98	1.1
42	12.999	α-Muurolene	0.45	1.52	0.81
43	13.500	α-Guaiene	----	-----	1.03
44	13.506	4-epi-cubedol	0.43	1.14	0.53
45	13.768	Dihydrocurcumene	-----	----	0.37
46	13.891	β-Resorcylic acid	0.52	0.42	0.89
47	13.970	3,5-di-t-Butyl-4-hydroxybenzyl ether	--	0.27	0.89
48	14.034	2,4-Di-tert-butylphenyl benzoate	---	0.47	0.67
49	14.361	24,25-Dihydroxyvitamin D3	0.65	-----	0.66
50	14.495	α-Cedrene	---	----	0.81
51	14.728	Syringic acid	---	0.76	0.57
52	14.932	Phytol	0.94	0.33	0.43
53	15.015	Chromone, 5-hydroxy-6,7,8-trimethoxy-2,3-dimethyl-	0.57	0.29	0.63
54	15.213	α-Dicarvelone	1.02	0.24	1.28
55	15.296	2',6'-Dihydroxyacetophenone	1.13	0.37	0.62
56	15.448	Nopol	---	3.6	1.41

Table 6. Cont.

No	RT	Compound	Raw seeds	Tap water	Saline water
57	15.633	Cyanidincation	0.55	0.33	0.46
58	15.842	Ascorbic acid, permethyl-	0.67	0.27	0.86
59	16.020	2,4-Di-tert-butyl-6-(tert-butylamino)phenol	1.05	6.58	0.62
60	16.821	Resorcinol	---	3.48	0.47
61	16.867	Isolongifolol	1.9	0.79	0.99
62	17.037	Patchoulol	0.80	1.20	1.15
63	17.062	Kampferol-3,4'-dimethyl ether	1.11	0.68	0.68
64	17.303	Quercetin 3',4',7-trimethyl ether	0.55	0.39	1.25
65	17.521	Levallorphan	---	---	1.38
66	18.781	Propyl gallate	---	---	1
67	20.198	Resveratrol	2.88	0.45	0.53
68	20.821	Isoorientin	---	0.55	1.11
69	21.429	Vanylglycol	---	0.92	1.5
70	22.480	Phenol, 4-tert-butyl	2.41	0.50	1.88
71	24.109	4-tert-Pentylphenol	1.25	0.65	3.17
72	6.304	3-Hydroxypyridine	0.67	----	---
73	9.874	m-Hydroxybenzoic acid	0.53	-----	-----
74	10.711	α-Curcumene	1.25	-----	--------
75	13.28	β-Cubebene	0.81	-----	------
76	13.356	γ-Gurjunene	0.93	-------	-------
77	14.211	Nerolidol	0.45	------	------
78	14.503	Quinoline, 2-methyl-	0.70	------	---
79	21.059	3-Methylkempferol	1.72	-----	------
80	23.091	3,5-di-t-Butylcatechol	2.10	----	----
81	23.558	3,4',5,6'-tetra-tert-butylbiphenyl-2,3'-diol	3.57	----	-----
82	9.364	endo-Borneol	----	1.65	-----

CONCLUSION

This study show that there was slightly increasing in protein, amino-acids and some minerals in sprouts using tap water and saline water. Whereas, there was a marked increasing in antioxidant activity, total phenols and total flavonoids in tap water and saline water sprouts.

Plants physiology changes and these dynamic changes in metabolites during sprouting process induce organic compounds as flavonoids, organic acids and phenolic compounds with significant antioxidant properties to increase in sprouting Faba bean seed irrigated either by tap water or saline water. The raise content of bioactive compounds causes that consumption of sprouts strengthens body's immunity. Therefore, accumulation of these secondary metabolites in plants provides health benefit foods.

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تأثير عملية الانبات بإستخدام الماء المملح على خصائص بذور الفول البلدى

[178]

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الموجـــــــز

تلعب البقوليات دورًا مهمًا في تغذية الإنسان في العديد من البلدان. الانبات هي واحدة من العمليات الأكثر فعالية لتحسين القيمة الغذائية البقوليات. وقد تم اختيار بذور الفول البلدى صنف سخا 4 لهذه الدراسة. لمقارنة التحليل الكيميائي والمحتويات الكيميائية النباتية للبذور غير المنبته والبذور المنبته بإستخدام ماء الصنبور والمياه المالحة بتركيزات مختلفة (1000- 2000-3000-4000 جزء فى المليون). بالإضافة إلى ذلك، مقارنة نشاط مضادات الأكسدة (مجموع مضادات الأكسدة والفينولات والفلافونويد) الفيتامينات بعض المركبات الاخرى التى غالبا مايتغيرتركيبها وتركيزها بشكل كبير أثناء عملية الإنبات.

وفقًا لنتائج قياس التنبيت باستخدام تركيزات مختلفة من ملح كلوريد الصوديوم لتقييم أداء تنبيت حبوب الفول البلدى، فإن النتيجة التي تم الحصول عليها تشير إلى أن تركيز 1000 جزء في المليون من ملح كلوريد الصوديوم هو التركيز المناسب لأداء تنبت حبوب الفول لبلدى لذا تم إختيار هذه المعاملة لإجراء التحليل الكيميائي وللتعرف على المركبات الكيميائية النباتية المفيدة فيها.

وقد أظهرت هذه الدراسة أن هناك زيادة في نسبة البروتين والأحماض الأمينية وبعض العناصر المعدنية عند إستخدام مياه الصنبور وبالأخص المياه المالحة في عملية الإنبات وكان هناك زيادة ملحوظة في نشاط مضادات الأكسدة، ومجموع الفينولات وإجمالي الفلافونويدات في ماء الصنبور وبالأخص المياه المالحة. ويتضح أن الإنبات يزيد من محتوى المغذيات الدقيقة والمغذيات النباتية للفول البلدى، مما يثبت أن هناك زيادة في القيمة الغذائية للبذور المستنبتة، هذا بالإضافة إلى أن الإنبات هو وسيلة جيدة لتعزيز خصائص مضادات الأكسدة في بذور البقوليات حيث كانت هناك زيادة في محتويات الفينول والفلافينويدات في نبت حبوب الفول البلدى خاصة مع استخدام تركيز ملح كلوريد الصوديوم كعامل محفز وبالتالي، يمكن استخدام عملية الإنبات كمصدر لمضادات الأكسدة الطبيعية في الأغذية الوظيفية. قد تكون هذه الدراسة وما شابها خطوة مهمة نحو التطور المستقبلي للأطعمة ذات القيمة المضافة والتي يمكن استخدامها في تطوير منتجات غذائية جديدة ذات تأثيرات مفيدة على صحة الإنسان.

الكلمات الدالة: الإنبات، الماء المملح، خصائص بذور الفول البلدي

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