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Productivity of some Faba Bean Cultivars and its Pan Bread Characteristics as influenced by Organic Fertilizers under Newly Reclaimed Salinity Sandy Soil

Badawy, R. A. [1*]; M. S. Abbas[2]; H. M. Abdel-Lattif[1] and Ashgan M. Aly[3]

[1] Agronomy Department, Faculty of Agriculture, Cairo University, Egypt
[2] Natural Resources Department, Faculty of African Postgraduate Studies, Cairo University, Egypt
[3] Department of Bread and Pasta Research, Food Technology Research Institute, Agricultural Research Center, Egypt

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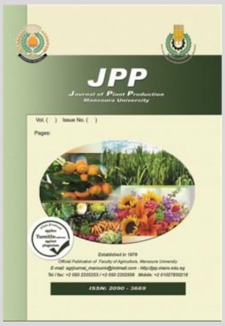

ABSTRACT

To evaluate the impact of organic ferilizer sources on productivity of faba bean cultivars grown under salinity conditions and to produce its pan bread healthy and nutritional by suitability of replacement of wheat flour by sprouts enriched selenium faba bean flour. Two field experiments were carried out during two successive seasons of 2016/2017 and 2017/2018 at the Desert Experimental Station, Faculty of Agriculture, Cairo University, Wadi El-Natroon, El-Beheira Governorate, Egypt. Data were collected at harvest on growth, yield components and yield of three faba bean cultivars under two types of organic applications. Seeds of faba bean cultivars obtained from field experiments were used for making pen bread and proximate analysis, physical, sensory properties, shelf life and amino acid content of pan bread were analyzed. The results indicated that the plant compost caused an increase of seed yield than in animal organic applications when applied on three faba bean cultivars. In particular, the interaction between Sakha-1 cultivar and plant compost resulted in the greatest values of grain yield under salinity conditions. Se- sprouts faba bean flour for Sakha-1 cultivar to partially substitute wheat flour in improving pan bread characteristics. The partially substituted due to improve protein, amino acid contents, Se content and shelf life during storage. It is possible to use Sakha-1 cultivar with plant compost to improve the productivity of faba bean under natural salinity conditions.Also, Se- sprouts broad bean flour made from Sakha-1 cultivar to partially substitute wheat flour for production specified pan bread to be suitable healthy nutritional.

Keywords: faba bean, growth, yield, pan bread, proximate, texture, amino acids

INTRODUCTION

Legumes are good sources of protein, complex carbohydrates, fiber and essential vitamins and minerals to the diet, which are low in fat and sodium and contain no cholesterol. Also legumes have better nutritional qualities than wheat, but deficient in sulphur containing amino acids (methionine and cysteine). However, with a small increase in one of these two amino acid, tryptophan of legume would become the next limiting amino acid in legume seeds. So fortification of wheat flour with non- wheat proteins, also, increase protein quality by improving its amino acid profiles (Pirman *et al*.; 2001 and Petrovska *et al*.; 2002).

Faba bean (*Vicia faba* L.) is the most important legume crop in Egypt. It serves as an important source of protein in the human diet also largely used for animal feed (Abdelhamid et al 2004 and Vioque *et al*., 2012). Faba bean are considerable among vegetables, legumes are considered either sensitive or only moderately tolerant to salinity. Several mechanisms are being developed by plants to induce tolerance to overcome the adverse effects of salinity including organic fertilizers and (Krieger-Liszkay and Trebst, 2006 and Semida *et al*. 2014).

Chemical fertilizers are generally applied to improve crop yield, but their long-term application enhances soil pH, decrease soil microorganism, increase pollution and disturbs the soil ecological balance (Ahmadian *et al*., 2011 and Bistgani *et al*., 2018). Therefore, demand for organic additions has increased due to health benefits and safe to environment (Sangkumchaliang and Huang, 2012). Also, organic fertilizers improve the physico-chemical and biological characteristics of soil, contributing to increase its fertility and reintegrating the organic substances which undergo natural mineralization processes (Cucci *et al* 2019).

Bread can be defined as a fermented confectionary product produced with the help of basic ingredients wheat flour, water, yeast and salt by undergoing series of phases or steps. Bread may be made from various cereals, grains and legumes. Modifications of wheat flour bread also called special breads by incorporating different functional ingredients like oat, rye, bacteria, barley, soybean, pulse flours, sprouted wheat flours, sprouted legumes or probiotic to improve the nutritional status of these functional breads which is also acceptable to consumers is becoming (Maneju *et al*., 2011).Germination is known to cause important changes in the biochemical, nutritional and sensory characteristics, and has been claimed to enhance the nutritive value of cereals and legumes. Legume sprouts are considered natural, healthy products that provide a source of bioactive compounds to fight against chronic diseases. Germinated legumes are a good source of highly bioavailable proteins, starch, lipids and minerals.

*** Corresponding author.**
E-mail address: elbadawy.w@gmail.com
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Additionally, germinated seeds contain significant amounts of vitamins and polyphenols with well documented pro-health properties (Cevallos-Casals and Cisneros-Zevallos, 2010; Ghiassi *et al*., 2012; Megat *et al*., 2016; Dominguez-Arispuro *et al*., 2018). Several studies have suggested that organic Se is usually less toxic and more bioavailable than inorganic Se (Brown *et al*., 2000).

Therefore, the present study is designed to evaluate two types of organic applications on productivity of faba bean grown in salinity conditions and to produce its pan bread to be suitable healthy nutritional by suitability of replacement of wheat flour by sprouts enriched selenium faba bean flour.

MATERIALS AND METHODS

Experimental Site

Two field experiments were carried out during two successive seasons of 2016/2017 and 2017/2018 at the Desert Experimental Station, Faculty of Agriculture, Cairo University, Wadi El-Natroon, El-Beheira Governorate, Egypt (30º32'30" and 30º 33'0" N, 29º 57'15" and 29º58'15" E and with an altitude of 31 and 59 meters (above sea level) under drip irrigation.

Soil physical analysis was conducted at Faculty of Agriculture Research Park, Cairo University according to Klute (1986) and chemical analysis was done according to Page et al., (1982). Soil of the experimental site was sandy texture, saline (the electrical conductivity (EC) of soil was5.12 and 5.72 dS/m respectively in both seasons and poor in macro nutrients. The soil available contents of N, P and K were (5.73-7.38, 2.33-2.57and 175– 149 mg kg^{-1}), respectively in both seasons. Also the soil was poor in organic matter content (1.01 and 0.94 %) in the two seasons, respectively (Table 1). Irrigation water was brackish; EC was 4.31 and 4.20 dS/m in the first and second seasons, respectively (Table 2). Little differences were registered for the vales of soil properties in the two seasons of the experiment.

Table 1. Soil properties at the experimental site in 2016/2017and 2017/2018 seasons.

Soil analysis	2016/17	2017/18
Physical properties		
Sand (%)	91.15	94.27
Silt (%)	6.35	4.20
Clay (%)	2.50	1.53
Texture class	Sandy loam	Sandy loam
Chemical properties		
pH $_{(1:1)}$	7.81	7.54
$EC_{(1:1)}$ (dS m^{-1})	5.12	5.72
Organic matter (%)	1.01	0.94
Total $CaCO_3$ (%)	4.14	6.31
Available N (mg kg^{-1})	5.73	7.38
Available P (mg kg^{-1})	2.33	2.57
Available K (mg kg^{-1})	175	149
Irrigation system	Drip irrigation	Drip irrigation

Table 2. Chemical properties of irrigation water at the experimental site in 2016/2017and 2017/2018 seasons.

		EC			Soluble ions (meq/L)				
Season	pH	(ds m^{-1})	HCO_3^-	CL^-	SO_4^-	Ca^{++}	Mg^{++}	Na^+	K^+
2016	7.27	4.31	3.14	27.12	8.43	4.69	3.71	41.32	1.04
2017	7.38	4.20	3.42	23.52	9.71	5.30	4.28	37.14	0.71

Treatments and experimental design

The present study was designed to include, three Egyptian commercial cultivars of faba bean namely (Sakha-4, Sakha-1 and Giza-843) which were provided from Agricultural Research Center (ARC), Giza, Egypt. Organic applications (control, plant compost and chicken manure "animal") were applied. The plant compost was obtained from Quesna Agricultural Development Company, Egypt while chicken manure was purchased from Agricultural Research and Experiment Station, of Faculty of Agriculture, Cairo University, Egypt and both of two organic applications were added with rate of 12 ton ha^{-1} before sowing. The composition of organic applications was presented in Table (3)

A split-plot design in a randomized complete block arrangement was used with four replications. The main plots were allotted to the two organic applications beside control, the three cultivars were devoted to sub-plots. Each sub-plot consisted of 5 ridges of 0.70 m in width and 6.0 m in length, *i.e.* the experimental plot area was 21 m^2.

Table 3. Physical and chemical properties of organic applications in 2016/2017and 2017/2018 seasons.

Bulk Density	Plant compost		Chicken manure	
(kg / m^3)	1^{st}Season	2^{nd}Season	1^{st}Season	2^{nd}Season
Moisture content (%)	25.00	24.00	22.00	23.00
pH $_{(1:10)}$	7.00	7.1	8.04	8.00
EC $_{(1:10)}$ (ds / m)	2.65	2.70	3.20	3.10
Total Nitrogen (%)	2.15	2.20	2.24	2.26
Organic Matter (%)	1.671	1.686	1.885	1.870
Organic Carbon (%)	38.90	38.85	17.98	17.95
Ash (%)	32.8	32.8	69.00	69.25
C: N Ratio	18:1	17.6:1	8:1	7.9:1
Total Phosphorus (P_2O_5) (%)	1.09	1.07	0.16	0.15
Total Potassium (%)	2.55	2.50	0.59	0.60
Weed seeds	-----	-----	-----	-----
Nematodes	-----	-----	-----	-----

Cultural practices

The preceding crop was peanut (*Arachis hypogaea*, L.) in both seasons. Sowing dates were on November 12 and 7 in 2016/17 and 2017/18 seasons, respectively. Seeds were sown in hills at 30 cm apart by hand on both sides of the ridge, thereafter (after 30 days from germination) were thinned to two plants per hill. Calcium super phosphate fertilizer (15.5% P_2O_5) at the rate of 60 kg P_2O_5per ha was applied uniformly before sowing. Nitrogen at rate of 45 kg N per ha in the form of ammonium nitrate (33.5% N) was added four times at sowing date one dose and the last three doses every ten days after germination. Potassium sulphate (48% K_2O) was applied at the rate of 120 kg K_2O per ha. Application of potassium fertilizer was started at 30 days after sowing through 8 equal doses at 7-day intervals. The weed management was carried out during the growing season by hoeing twice. The other cultural practices were applied as recommended by the Agricultural Research Center (ARC), Giza, Egypt**.**

Data collection

Agronomic traits:

At harvest, 20 guarded plants were randomly taken from each sub plot to determine the following traits: plant height, number of tillers, number of pods/plant, number of seeds/plant, yield/plant, seed index (%), biological yield (ton. ha^{-1}) and harvest index (%). In addition, seed yield (ton ha^{-1}) was weighed from the whole area of each sub plot and adjusted to yield per hectare.

Materials:

Wheat flour (72%) extraction rate was obtained from Al-Salam- Company for Milling and Baking.

Seeds of faba bean cultivars (Sakha-4, Sakha-1and Giza-843) obtained from field experiments explore to organic applications and control which produced under soil salt condition were used.

Baking Ingredients: yeast, sugar, corn oil and salt were obtained from local market Giza, Cairo, Egypt.

Methods:

Preparation enriched selenium broad sprouts flour:

The seeds were germinated according to Diowksz *et al.* (2014). All samples were stored in airtight containers and kept at 3–4°C until required.

Preparation of blends: addition level of sprout the three cultivars (Sakha-4,Sakha-1andGiza-843) of faba bean sprouts flour used at 30% to wheat flour 72% extraction rate and blended, then used for pan bread making.

Pan bread production

Pan bread made according to the previous method which described by Samar *et al*., (2001).

Physical analysis of pan bread

The average weight (g), volume (cm^3) and specific volume of pan bread were determined according to the method of A.A.C.C, (2002).

Sensory evaluation

Ten panelists (4 males and 6 females) specialized in bread and pastries from Bread and Pasta department, Food Technology Research Institute (FTRI), Agriculture Research Center, Egypt, were selected to conduct sensory assessment tests. Before the test, panelists were given some information on the importance of the experience. Panelists were re-briefed on use of hedonic scale questionnaire to evaluate the bread. Testing session lasted approximately 15 minutes. Pan bread was evaluated as the method described by Pyler, (1973) for general appearance (10), crust color (10), volume (10), crumb color (20), crumb grain (20), softness (10), taste (10), odor (10) and overall score (100).

Proximate analysis

Moisture, protein, ash, crude fiber and ether extract were determined in raw material and product according to the methods described in A.A.C.C., (2000). Total carbohydrates were calculated by difference.

Determination of minerals

Two gram of sample was weighed and heated at 550 ºC. Then the ashes were dissolved with 100 ml 1M HCl. Dissolved ash was analyzed for zinc, iron, calcium, potassium, sodium and magnesium contents by using methods of A.A.C.C., (2000). Perkin Elmer (Model 3300, USA) Atomic Absorption Spectrophotometer was used to determine these minerals.

Sprouts and Bread digestion for determination selenium

Samples were digested according to the method described by Renard and Tompkins (2002). Diluted sample digests were also analyzed in triplicate (Perkin Elmer).

Texture analysis

A texture analyzer (BROOKFIELD CT3 TEXTURE ANALYZER Operating Instructions Manual No. M08-372-C0113, Stable Micro Systems, USA) was used to measure the texture profile of pan bread in terms of hardness (N), cohesiveness, Gumminess (N), Chewiness (mj),Adhesiveness (mj), springiness (mm) and Resilience of the samples according to the method described by Gomez *et al*. (2007).

Determination of Amino Acids:

Amino acid compositions were determined according to the method described in A.A.C.C., (2000)..

Statistical analysis

Test of normality distribution was carried out according to Shapiro and Wilk method (1965), by using SPSS v. 17.0 (2008) software package. Also, data of agronomic traits were tested for validation of assumptions underlying the combined analysis of variance by separate analyzing of each season and then combined analysis across the two seasons was performed if homogeneity (Bartlet test) was insignificant, while data of food product (broad bean) was analyzed according a split -plot design only. Estimates of LSD were calculated to test the significance of differences among means according to Snedecor and Cochran, (1994).

RESULTS AND DISCUSSION

Analysis of variance

The analysis of variance regarding all traits studied for all cultivars under the two types of organic applications across seasons is presented in Table (4). Mean squares of seasons were significant ($P\leq 0.05$ or $P\leq 0.01$) for all studied traits, except harvest index and number of branches per plant, indicating the effect of climatic conditions on most studied characters. However, mean squares of organic applications were significant ($P\leq 0.05$ or $P\leq 0.01$) for all traits, number of branched/plant, suggesting that the organic applications type had a significant effect on most studied traits. Also, mean squares of cultivars were significant ($P\leq 0.05$ or $P\leq 0.01$) for all traits, except number of seeds/plant, indicating the effect of genetic background of studied cultivars on most studied traits. Furthermore, mean square of the interactions between organic applications and cultivars was significant ($P\leq 0.05$ or $P\leq 0.01$) for all studied traits, except number of branches per plant.

Table 4. Combined analysis of variance of split plot design for three faba bean cultivars evaluated under organic applications across 2016/17 and 2017/18 seasons

S.V	df	Plant Height	No. of Branches/Plant	No. of Pods/Plant	No. of Seeds/plant	Yield/ Plant	Seed Index	Biological Yield	Harvest Index	Seed Yield
Years (Y)	1	1521**	0.117	4.06**	276**	120**	56.6*	15.92**	0.990	1.87**
Reps/Y	6	14.40*	0.208	0.114	0.20	0.241	6.16	0.55	9.23	0.02**
Organic Applications (A)	2	260**	0.117	13.8**	61**	76.3**	236**	5.65**	82.4**	1.63**
AY	2	1.90	0.108	0.568	4.8**	15.5**	95**	0.94	4.96	0.24**
Error	12	4.40	0.173	0.334	0.457	0.102	7.69	0.28	11.75	0.003
Cultivar (B)	2	479**	0.52**	16.3**	74.32	116**	140**	12.78**	56.8**	0.77**
BY	2	1.3	0.20**	0.275	1.9**	13.1**	8.71	0.34*	7.80	0.04**
AB	4	6.0*	0.03	0.146*	1.4**	4.7**	11.4*	0.54**	24.8**	0.02**
ABY	4	3.70	0.094	0.224	1.9**	2.1**	4.17	0.49**	28.5**	0.03**
Error	36	2.70	0.03	0.133	0.146	0.122	4.05	0.09	3.09	0.002

***and** indicate significant and highly significant at 0.05 and 0.01 levels of probability respectively.**

Effect of faba bean cultivars and organic applications

Significant (P ≤ 0.05) differences were observed between two types of organic applications on all studied traits, expect number of branches /plant. Generally, there was a significant increase in all studied growth, components of yield and grain yield by applying of two types of organic applications. The results of Table (5) also revealed that, plant compost resulted in the greatest values of plant height (59.54 cm), number of branches /plant (2.35), number of pods/plant (9.76), number of seeds/plant (24.20), yield/plant (22.48 g), seed index (90.34 g), biological yield ha^{-1} (7.70 ton), harvest index (37.01 %) and seed yield ha^{-1} (2.80 ton).

Results showed a significant effect between three cultivars of faba bean at the probability level of 5% of all the studied traits except, number of seeds/plant. Table (5) showed that Sakha-1cultivar resulted in the greatest values of plant height (60.62 cm), number of branches /plant (2.44), number of pods/plant (9.87), yield/plant (22.85 g), seed index (92.56 g), biological yield ha^{-1} (7.65 ton), harvest index (35.85 %) and seed yield ha^{-1} (2.70 ton). On the contrary, the lowest values of all studied traits of growth, yield and its components were recorded for Giza-843cultivar while Sakha-4 cultivar resulted in the moderate values of all studied trait.

Table 5. Mean performance of growth, yield components and yield for faba bean cultivars and organic applications (data are combined across 2016/17 and 2017/18 seasons)

Organic Applications	Cultivars	Plant Height (cm)	No. of Branches /Plant	No. of Pods/ Plant	No. of Seeds /Plant	Yield/ plant (g)	Seed Index (g)	Biological Yield (ton/ha)	Harvest Index (%)	Yield (ton/ ha)
Control		53.03	2.31	8.87	22.69	19.04	86.58	6.82	37.03	2.48
Chicken manure		55.42	2.22	8.24	21.01	19.95	92.81	6.9	33.81	2.29
Plant compost		59.54	2.35	9.76	24.2	22.48	90.34	7.7	37.01	2.8
$LSD_{0.05}$		1.86	ns	0.51	0.61	0.28	2.46	0.86	3.05	0.05
	Giza-843	51.7	2.14	8.26	20.92	18.49	87.8	6.3	37.54	2.34
	Sakha-4	55.68	2.29	8.74	22.54	20.13	89.37	7.46	34.47	2.53
	Sakha-1	60.62	2.44	9.87	24.44	22.85	92.56	7.65	35.85	2.7
$LSD_{0.05}$		1.37	0.15	0.3	ns	0.28	1.67	0.25	1.46	0.04
	Giza-843	49.69	2.16	8.08	21.25	17.42	85.47	6.01	39.3	2.35
Control	Sakha-4	52.33	2.36	8.66	22.51	18.59	85.01	7.28	34.37	2.47
	Sakha-1	57.07	2.41	9.87	24.31	21.1	89.26	7.16	37.43	2.64
	Giza-843	50.76	2.12	7.71	19.47	18.17	90.93	5.98	35.56	2.09
Chicken manure	Sakha-4	55.7	2.18	7.94	21.05	20.05	92.93	7.39	31.21	2.26
	Sakha-1	59.8	2.35	9.08	22.51	21.63	94.56	7.32	34.68	2.5
	Giza-843	54.64	2.16	8.98	22.04	19.88	87.01	6.92	37.77	2.58
Plant compost	Sakha-4	59.02	2.34	9.63	24.08	21.75	90.18	7.69	37.83	2.87
	Sakha-1	64.98	2.56	10.65	26.49	25.81	93.85	8.47	35.45	2.96
$LSD_{0.05}$		2.37	ns	0.52	0.54	0.5	2.89	0.43	2.52	0.06

ns= non-significant.

Effect of interaction between faba bean cultivars and organic applications

Results of the present study indicated that the interaction two studied factors as did put a significant effect on all the studied traits except from number of branches /plant, However, results in Table (5) showed that, for the interaction between Sakha-1cultivar and plant compost resulted in the greatest values of plant height (64.98 cm), number of pods/plant (10.65), number of seeds/plant (26.49), yield/plant (25.81 g), biological yield ha^{-1} (8.47 ton), harvest index (35.45 %) and seed yield ha^{-1} (2.96 ton) were observed with significant differences and number of branches /plant (2.56) without significant differences. on other hand, the interaction between Sakha-4 cultivar and animal organic application resulted in the greatest value of seed index (94.56 g) with significant differences.

The observed significant influence of organic fertilization conditions on productivity of different faba bean cultivars was in agreement with other authors. In particular, the plant compost caused an increase of grain yield than in animal organic applications when applied on three faba bean cultivars. These findings confirm that the use of compost or other organic fertilizers determine the release of macro and micro nutrients that improve the physical properties of soil with consequent increase of faba bean growth and yield, as observed by Cucci *et al.*, (2019) and Abdelhamid *et al.*, (2004) who used plant compost compare to poultry manure. However, the role of organic amendments for improvement of growth and yield parameters of faba bean has been reported by different researchers Chinthapalli *et al.*, (2015) and Tadele *et al.*, (2016).

Proximate analysis of faba bean cultivars selenium sprouts flour

Proximate analysis of faba bean cultivars selenium sprouts flour are presented in Table (6) results showed that the protein and fiber content had the highest values (24.32 and 1.09 %) in Se- sprouts of Sakha-1 cultivar treated with plant compost. Data showed also that ether extract was high in Se- sprout of Sakha-1 cultivar treated with animal compost (2.11%). Ash content was highest value (3.97%) in Se- sprout ofSakha-4 cultivar treated with plant compost. On the other hand, the highest value of carbohydrate content was recorded in Se- sprout control for Giza-843cultivar. This result agreement with Turco *et al.* (2016), Luo *et al.* (2013) and Crepon *et al.* (2010). Germinated legumes are a good source of highly bio-available proteins, starch, lipids and minerals (Cevallos-Casals and Cisneros-Zevallos, 2010).

Table 6. Proximate analysis (%) of faba beancultivars selenium sprouts flour

Cultivars	Organic Applications	Protein	Ash	Crude fiber	Ether extract	Carbohydrate
	Control	21.72	3.27	0.89	1.36	72.76
Sakha-4	Chicken manure	22.81	3.76	0.93	1.41	71.09
	Plant compost	23.25	3.97	1.05	1.74	69.99
	Control	23.07	3.15	0.92	1.19	71.68
Sakha-1	Chicken manure	23.41	3.43	0.94	2.11	70.11
	Plant compost	24.32	3.63	1.09	1.9	69.07
	Control	20.03	3.07	0.86	1.30	74.75
Giza-843	Chicken manure	20.96	3.30	0.93	1.16	73.63
	Plant compost	21.38	3.30	0.93	1.24	73.15

Mineral contents of faba bean cultivars selenium sprouts flour

The mineral contents of faba bean cultivars selenium sprouts flour are presented in Table (7).The Se- sprouts of Sakha1cultivar which treated with plant compost resulted in the greatest values of mineral content for Ca; Mg; Mn; Fe and Se while, Giza-843 cultivar which treated with plant compost resulted in the greatest values of K and Cu, while Zn had a high content in Sakha-4cultivar which treated with plant compost. From this results indicated that fertilizer with plant compost is highest in mineral content may be to due raising mineral in humic plant and germination process due to active enzymes and increased the mineral content in sprouts and increased availability. This results agreement with Luo and Xie, (2014); Oghbaei and Prakash (2016). While, Yousif and Safaa, (2014) showed that the mineral content decreased by germination. This reduction could be due to leaching of solid matter in soaking water. Also, Luo *et al.* (2009) reported that the expected improvement of iron bioavailability levels due to lower phytic acid was not confirmed by increasing levels of *invitro* soluble iron while, soaking, germination and fermentation can decrease phytic acid in faba bean.

Table 7. Mineral contents of faba bean cultivars selenium sprouts flour (mg/ Kg sample ppm)

Cultivars	Organic Applications	Ca	Mg	Mn	K	Cu	Fe	Zn	Se
	Control	8021.48	1282.33	111.71	5792.35	150.02	81.37	366.47	12.72
Sakha-4	Chicken manure	8119.91	1311.85	111.94	5855.91	167.97	88.84	409.37	13.70
	Plant compost	8170.89	1330.62	124.76	5866.18	176.07	171.90	510.20	13.81
	Control	7949.62	1200.38	102.00	5653.29	126.94	91.32	368.44	13.75
Sakha-1	Chicken manure	8050.58	1347.63	130.34	5733.26	172.05	167.98	456.53	14.75
	Plant compost	8179.09	1451.06	146.93	5694.16	185.66	415.01	494.46	15.70
	Control	7582.74	1248.93	102.99	5791.57	124.35	82.32	378.64	13.10
Giza-843	Chicken manure	7986.23	1251.40	111.19	5894.01	211.87	92.33	500.82	13.72
	Plant compost	8148.74	1272.20	113.08	6019.26	214.86	96.55	532.83	13.82

Physical properties of pan bread made of selenium sprout faba bean cultivars and wheat flour

The physical properties of pan bread prepared from wheat flour (control) and substituted with Se- sprouts bean cultivars flour are shown Table (8).The highest weight of pan bread of substituted cultivars was recorded in Se- sprout of Giza-843 substituted (191.49 g).

Table 8. Physical properties of pan bread made from substituted faba bean cultivars selenium sprouts flour

Cultivars	Organic Applications	Weight(g)	Volume(cm^3)	Specific volume(cm^3/g)
Flour wheat 100%		185.10	675.00	3.65
Sakha-4		191.27	593.33	3.10
Sakha-1		188.49	605.83	3.22
Giza-843		191.49	610.83	3.19
$LSD_{0.05}$		2.62	27.14	0.19
	Control	188.67	605.63	3.21
	Chicken manure	189.82	623.75	3.29
	Plant compost	188.78	634.38	3.36
$LSD_{0.05}$		1.40	8.24	0.03
Flour wheat 100%	Control	185.10	675.00	3.65
	Control	191.00	590.00	3.09
Sakha-4	Chicken manure	192.26	600.00	3.12
	Plant compost	190.56	590.00	3.10
	Control	188.85	597.50	3.17
Sakha-1	Chicken manure	188.66	595.00	3.16
	Plant compost	187.95	625.00	3.33
	Control	189.73	560.00	2.95
Giza-843	Chicken manure	193.26	625.00	3.24
	Plant compost	191.50	647.50	3.38
$LSD_{0.05}$		3.09	24.94	0.15

The volume and specific volume had the highest value was recorded in pan bread from wheat flour 100 % (control) followed by bread Se- sprout of Giza-843 and Sakha-1 cultivars substituted (675.00 and 610.83cm3), (3.65 and 3.22cm3) respectively, the highest volume and specific volume were recorded in plant compost (634.38 and 3.36cm3) respectively. The reason for the decreased volume is mainly the decrease in the amount of gluten caused by the addition of materials from which it is not possible to isolate gluten. The ability to keep ferment gas during the rising of dough is also lowered and consequently it influences the lower volume and lower porosity of pastries (breads) (Bojňanská *et al*., 2012). Sozer *et al.* (2019) found that both fermented and unfermented faba bean flour resulted in larger bread volume (2.1 and2.4mL/g, respectively).

Sensory evaluation of pan bread made of selenium sprout faba bean cultivars and wheat flour

Data of sensory evaluation indicated that all bread obtained from three cultivars at substitute (30%) had significant difference at 5% comparing with control (100% wheat flour) in overall score (Table 9), expect softness and taste. Also, the differences between organic applications (plant and animal) were non-significant in all properties expect crumb grain and odor. While pan bread produced from cultivars incorporating with treatment compared control (100% wheat flour) recorded lowest significant difference in overall score. Additional general appearance, volume, softness and taste not recorded significant difference in all bread compared with control (100% wheat flour). On the other hand, the sensory results indicated that control bread had the highest overall acceptability score followed by bread from substitute Se- sprouts Sakha-1 cultivar treated with compost plant; Se- sprouts Giza-843 treated with plant and animal compost(95.5, 94.38 and 94.38) respectively. Hefnawy *et al*., (2012) reported that the influence substitution at 15 and 30% of wheat flour by chickpea flour on the quality characteristics of toast bread, gives parameter values at least as good as the control sample and produces an acceptable toast bread.

Table 9. Sensory evaluation of pan bread made from substituted faba bean cultivars selenium sprouts flour

Cultivars	Organic Applications	General Appearance (10)	Crust Color (10)	Volume (10)	Crumb Color (20)	Crumb Grain (20)	Softness (10)	Taste (10)	Odor (10)	Overall Score (100)
Flour wheat 100%		9.75	9.75	9.75	19.75	19.75	9.75	9.75	10.00	98.25
Sakha-4		9.21	8.75	8.75	18.04	18.50	9.08	9.08	9.00	90.42
Sakha-1		9.58	9.33	9.25	18.92	19.08	9.33	9.08	9.00	93.58
Giza-843		9.54	9.50	9.38	18.92	18.83	9.23	9.17	9.21	93.79
$LSD_{0.05}$		0.40	0.66	0.73	0.73	0.76	ns	ns	0.37	4.19
	Control	15.78	15.57	15.42	31.25	31.56	15.52	15.37	15.21	155.68
	Chicken manure	15.89	15.47	15.37	31.67	31.56	15.52	15.42	15.52	156.41
	Plant compost	15.94	15.63	15.63	31.62	32.08	15.71	15.57	15.78	157.97
$LSD_{0.05}$		ns	ns	ns	ns	0.31	ns	ns	0.32	ns
Flour wheat 100%	Control	9.75	9.75	9.75	19.75	19.75	9.75	9.75	10.00	98.25
	Control	9.25	9.00	8.75	18.25	18.25	9.00	9.00	8.75	90.25
Sakha-4	Chicken manure	9.25	8.75	8.75	18.00	18.25	9.00	9.00	9.00	90.00
	Plant compost	9.13	8.50	8.75	17.88	19.00	9.25	9.25	9.25	91.00
	Control	9.50	9.25	9.25	18.50	19.00	9.25	9.00	8.75	92.50
Sakha-1	Chicken manure	9.50	9.00	9.00	19.00	19.00	9.25	9.00	9.00	92.75
	Plant compost	9.75	9.75	9.50	19.25	19.25	9.50	9.25	9.25	95.50
	Control	9.38	9.38	9.25	18.50	18.75	9.25	9.13	9.00	92.63
Giza-843	Chicken manure	9.63	9.63	9.38	19.25	18.75	9.25	9.25	9.25	94.38
	Plant compost	9.63	9.50	9.50	19.00	19.00	9.20	9.13	9.38	94.38
$LSD_{0.05}$		ns	0.95	ns	0.97	0.82	ns	ns	0.62	5.19

ns= non-significant.

Proximate analysis of pan bread made of selenium sprout faba bean cultivars and wheat flour

Table (10) presented that, the proximate composition of pan bread at substitute level (30%) from Se- sprouts broad bean cultivars with significant differences. The highest values for protein, crude fiber, ether extract were recorded in bread Se- sprouts made from Sakha1cultivar (15.39, 1.03 and 7.99 %) respectively, while the highest value of ash was recorded in bread Se- sprouts made from Giza-843cultivar.

Table 10. Proximate analysis (%) of pan bread made from faba bean cultivars selenium sprouts

Cultivars	Organic Applications	Protein	Ash	Crude fiber	Ether extract	Carbohydrate
Flour wheat 100%		12.11	1.79	0.67	6.13	79.31
Sakha-4		13.58	3.18	0.99	6.76	75.49
Sakha-1		15.39	3.21	1.03	7.99	72.40
Giza-843		14.90	3.32	1.00	7.73	73.00
$LSD_{0.05}$		0.32	0.01	0.006	0.16	0.35
	Control	13.75	2.83	0.90	6.68	75.84
	Chicken manure	13.85	2.83	0.91	7.30	75.11
	Plant compost	14.39	2.96	0.96	7.47	74.20
$LSD_{0.05}$		0.15	0.02	0.007	0.14	0.17
Flour wheat 100%	Control	12.11	1.79	0.67	6.13	79.31
	Control	13.11	3.16	0.98	5.95	76.80
Sakha-4	Chicken manure	13.07	3.06	0.96	7.05	75.86
	Plant compost	14.55	3.32	1.04	7.27	73.83
	Control	15.18	3.18	0.99	7.21	73.44
Sakha-1	Chicken manure	15.29	3.16	1.01	8.01	72.54
	Plant compost	15.70	3.29	1.10	8.77	71.21
	Control	14.59	3.21	0.96	7.44	73.80
Giza-843	Chicken manure	14.92	3.30	1.02	8.02	72.74
	Plant compost	15.19	3.44	1.03	7.72	72.47
$LSD_{0.05}$		0.34	0.03	0.012	0.28	0.39

The highest value of carbohydrate was recorded in bread control (100% wheat flour) (79.31%). In the same table proximate composition for bread three cultivars incorporated with compost treatment and compared bread control showed that bread Se- sprouts Sakha1 cultivar treated with plant compost had highest value (15.70, 1.10, 8.77%) for (protein, crude fiber, ether extract) respectively and the highest value of ash was recorded in bread Se- sprouts made from Sakha4 cultivar treated with plant compost (3.32 %).From table indicated that Se- sprouts for bean cultivars improve the protein content. Therefore, supplementation of wheat flour with Se- sprouts bean has been advocated as way of combating protein- calorie malnutrition and as functional bread. Abou-Zaid *et al*. (2011) reported that germinated legumes, as a source of proteins, could primarily be used in cereal products to improve nutritional properties. However, Abdel-Kader (2001) reported that enrichment of Egyptian balady bread with Decorticated cracked broad beans flour at 5, 10, 15 and 20% of the wheat flour was increased from 0 to 20%, there was an increase of 36% in protein, 18% in fat. Also, Viswanathan and Ho (2014) reported that breads made using 15% legume flour was comparatively equal in protein content, with overall acceptable quality.

Minerals content in pan bread from Se- sprouts broad bean cultivars

Minerals content of all prepared bread was measured and listed in Table (11). Results indicated that the bread made from substitute Sakha-1cultivar which fertilizer with plant compost resulted in the greatest values of mineral contents, Ca, Mg and Se (15860, 840.7 and 12.5) respectively compared to bread made from substitute Sakha-4cultivar which treatment with plant compost resulted in the greatest values of Mn and Fe (14.6 and 224.1) respectively. Also, the bread made from substitute Giza-843cultivar which treated with plant compost resulted in the greatest values of K and Zn (6718.3 and 25.9) respectively. From this results in Table (6 and 2) indicated that fertilizer with plant compost is highest in mineral content may be to due raising mineral in humic plant and germination process due to releasing mineral content in sprouts to due active enzymes. Abdel-Kader (2001) studied that fortification wheat bread with Decorticated cracked broad beans flour was increased from 0 to 20%, there was an increase of in 123% in calcium, 52% in phosphorus and 40% in iron contents. Similarly, Bojňanská *et al*. (2012) reported that during the baking experiment crumb acidity increased with the addition of lentil and chickpea, thus the bread became tastier and richer.

Table 11. Mineral content of pan bread made from faba bean cultivars selenium sprouts mg/Kg sample (ppm)

Cultivars	Organic Applications	Ca	Mg	Mn	K	Fe	Zn	Se
Control(Wheat flour100%)		1198.3	345.8	12.0	707.8	151.5	15.9	9.6
Sakha-4	Control	1571.1	376.9	14.4	4134.2	160.2	16.4	10.4
	Chicken manure	1572.1	488.8	14.5	4134.6	218.1	21.8	10.7
	Plant compost	1577.2	576.9	14.6	4136.6	224.1	24.9	11.9
Sakha-1	Control	1415.9	574.0	11.0	5767.0	222.9	23.2	12.0
	Chicken manure	1576.7	834.0	13.6	6215.2	184.1	25.3	12.4
	Plant compost	1586.0	840.7	13.6	6216.9	188.1	25.7	12.5
Giza-843	Control	1401.3	508.2	13.7	6701.7	148.5	24.8	10.3
	Chicken manure	1410.3	518.3	13.8	6711.8	152.3	24.9	10.4
	Plant compost	1411.3	530.1	13.1	6718.3	155.6	25.9	10.6

Texture analysis of pan bread from Se- sprouts broad bean cultivars

Data presented in Table (12) showed that, the texture analysis of pan bread from Se- sprouts under different storage periods at room temperature. The firmness was increased value in storage period. Whereas, the lowest value of firmness was recorded in bread from Se- sprouts Giza-843cultivar which treated with plant compost within storage period compared to other treatments.

Table 12. Texture parameters of pan bread during the storage

Characteristics	Storage time	Control (Wheat flour100%)	Sakha-4			Sakha-1			Giza-843		
			Control	Chicken manure	Plant compost	Control	Chicken manure	Plant compost	Control	Chicken manure	Plant compost
Firmness	Zero Time	11.75	26.63	15.03	21.16	16.89	17.18	16.90	21.57	16.54	15.52
	24hr	19.17	29.14	16.46	22.70	27.65	19.73	19.25	27.30	16.89	18.01
	48hr	23.37	35.43	18.70	30.32	30.65	24.84	30.03	39.78	19.31	22.07
Cohesiveness	Zero Time	0.67	0.58	0.48	0.49	0.49	0.52	0.52	0.53	0.50	0.51
	24hr	0.56	0.46	0.45	0.44	0.40	0.43	0.42	0.50	0.49	0.50
	48hr	0.43	0.40	0.42	0.43	0.37	0.42	0.39	0.38	0.40	0.38
Gumminess	Zero Time	8.12	10.32	9.40	13.73	8.80	13.14	9.52	12.18	8.88	8.42
	24hr	8.70	11.33	7.83	10.37	10.94	8.50	8.34	12.41	7.01	9.44
	48hr	13.80	23.48	6.68	16.68	13.76	13.71	14.22	24.29	10.11	9.58
Chewiness	Zero Time	36.60	46.90	28.80	46.90	39.00	37.60	32.10	61.20	25.20	31.00
	24hr	37.50	57.60	36.80	78.80	53.30	74.10	51.90	75.90	42.20	38.90
	48hr	37.50	145.80	42.20	92.20	83.70	74.30	52.90	143.50	50.10	51.10
Springiness	Zero Time	4.51	6.21	4.70	5.74	6.08	5.64	5.55	6.23	4.96	5.34
	24hr	4.27	5.58	4.49	5.53	4.87	5.42	3.85	5.91	4.75	4.62
	48hr	4.13	4.14	4.31	4.88	4.43	4.42	3.65	4.93	3.60	3.28
Resilience	Zero Time	0.24	0.11	0.12	0.10	0.12	0.11	0.14	0.14	0.13	0.13
	24hr	0.21	0.09	0.10	0.09	0.08	0.70	0.09	0.08	0.12	0.07
	48hr	0.15		0.09						0.09	

Also, all cultivars were recorded the lowest value for other parameter (cohesiveness, gumminess, springiness, and resilience) under different storage period compared to control bread. While, chewiness was recorded the highest value in all pan broad bean made from three cultivars bread compared with the control bread within storage period. This results probably due to raising protein content in broad bean bread that had high water absorption indicated that fermentation of faba flour priorto bread making significantly increased crumb hardness.

Amino acid of pan bread from Se- sprouts broad bean cultivars

Results in Table (13) showed that the amino acid composition of pan bread from Se- sprouts broad bean Sakha cultivar under two organic applications compared to bread control. The highest values of essential amino acid were recorded in pan bread from Se- sprouts fromSakha-1cultivar treated with animal and plant compost compared to control bread. Pan bread from Sakha-1 cultivar treated with plant compost resulted in the greatest values of cysteine, tryptophan and methionine. While the greatest values of non-essential amino acid recorded in bread from Sakha-1cultivar treatment with animal and plant compost compared to bread control except glutamic and serine. Also the amino acid as methionine and cysteine recorded highest in broad bean bread due to germination with Se- compound in sprout water.

Table 13. Amino acid composition of pan bread from Se- sprouts faba bean fromSakha-1 cultivar (g/100g protein)

Amino acids	Control bread	Sakha-1	
	Flour wheat 100%	Chicken manure	Plant compost
Essential Amino Acid			
Lysine	2.40	3.86	3.64
Leucine	5.95	6.48	6.06
Phenyl alanin	3.96	4.19	3.95
Threonine	2.73	3.14	2.68
Isoleucine	2.97	3.34	3.12
Valine	3.55	3.99	3.76
Methionine	1.57	1.54	1.91
Cystine	2.31	2.09	2.68
Tryptophan	1.23	1.41	1.60
Histidine	1.98	2.29	2.10
Tyrosine	3.06	3.27	2.74
Total essential amino acid	31.71	35.6	34.24

The greatest value of proline was recorded in faba bean pan bread comparing with control pan bread that may be due to exposure to salt stress within field experiments. Legume proteins can be successfully used in baked products to obtain a protein-enriched product with improved amino acid balance (Bojňanská *et al*., 2012; Mohammed *et al*., 2012). The potential use of legumes as protein-enriching agents of baked products, mainly in the form of protein flours, has been reported by several authors. Sozer *et al.* (2019) reported that essential amino acid and biological value indexes was significantly increased for breads containing fermented faba flour. Moreover, Fenn *et al.* (2010) found that the addition of 2% soybean protein to wheat flour would increase lysine content by 28%.

Significance Statement

The interaction between Sakha-1 cultivar and plant compost resulted in the greatest values of seed yield under natural salinity conditions and it is possible to use Se- sprouts faba bean flour for Sakha-1 cultivar to partially substitute wheat flour to improve pan bread characteristics and produce specified pan bread to be suitable healthy nutritional.

CONCLUSIONS

In this study conclusion, the interaction between Sakha-1 cultivar and plant compost resulted in the greatest values of grain yield under salinity conditions and it is possible to use Se- sprouts broad bean flour for Sakha-1 cultivar to partially substitute wheat flour in improving pan bread characteristics. The partially substituted due to improve protein, amino acid contents, Se content and shelf life during storage as well as production specified pan bread to be suitable healthy nutritional.

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تأثر إنتاجية بعض أصناف الفول البلدي وخصائص خبز القوالب المنتج منه بالأسمدة العضوية المختلفة تحت ظروف الأراضى الرملية حديثة الإستصلاح والمتأثرة بالأملاح

رمضان عبد الواحد بدوي[1]، محمد سعيد عباس[2]، هاشم محمد عبد اللطيف[1] و اشجان محمد علي[3]

[1]قسم المحاصيل – كلية الزراعة – جامعة القاهرة

[2]قسم الموارد الطبيعية – كلية الدراسات الافريقية العليا – جامعة القاهرة

[3]قسم الخبز والعجائن – معهد بحوث تكنولوجيا الاغذية – مركز البحوث الزراعية

لتقييم تاثير الاضافات العضوية على إنتاجية الفول البلدي المزروع تحت ظروف الملوحة خصائص خبز القوالب المنتج من خلال استبدال دقيق القمح بالدقيق الناتج من نموات بذور الفول البلدي والغنية بالسيلينيوم. أجريت تجربتين حقليتين خلال موسمين متتاليين 2017/2016 و 2018/2017 بالمحطة البحثية - كلية الزراعة - جامعة القاهرة - وادي النطرون - محافظة البحيرة – جمهورية مصر العربية حيث تم استخدام تصميم القطع المنشقة بتصميم القطاعات كاملة العشوائية بأربعة مكررات. تم تخصيص قطع الأرض الرئيسية للتطبيقين العضويين بجانب الكنترول، وقد خصصت الأصناف الثلاثة للقطع المنشقة مرة احدة. تم جمع البيانات عند الحصاد عن النمو ومكونات المحصول وتم استخدام بذور أصناف الفول البلدي المنتجة من التجارب الحقلية لانتاج خبز القوالب واجريت عليه التحليلات الكيميائية وتحليل الخصائص الفيزيائية والحسية ومدة الصلاحية ومحتوى الأحماض الأمينية. وأشارت النتائج إلى أن الاضافة العضوية النباتية أدت الي زيادة محصول البذور مقارنة بالاضافة العضوية الحيوانية وذلك على الاصناف الثلاثة المنزرعة. وانتج التفاعل بين صنف سخا 1 والاضافة العضوية النباتية أعلى قيم لمحصول البذور تحت ظروف الملوحة. كما ان استخدام دقيق نموات الفول البلدي لصنف سخا 1 ليحل جزئيا محل دقيق القمح أدت الي تحسين خصائص خبز القوالب المنتج من خلال تحسين محتوى البروتين والأحماض الأمينية ومحتوى عنصر السلينيوم ومدة الصلاحية أثناء التخزين. ويستخلص من الدراسة ان استخدام الصنف سخا 1 مع الاضافة العضوية النباتية له تاثير معنوي عليتحسين إنتاجية الفول البلدي تحت ظروف الملوحة واستخدام دقيق النموات الفول البلدي من نفس الصنف ليحل محل دقيق القمح جزئياً لإنتاج خبز القوالب ذو الخصائص الغذائية والصحية الهامة.

الكلمات الدالة: الفول ، النمو، المحصول، الخبز، التحليل الكيميائي، الملمس، الأحماض الأمينية