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Utilization of Enriched Selenium Sprouts Flour for Some Cultivars of Broad Bean to Prepare Healthy Biscuit

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Abstract

Present study was assessed physical characteristics, sensory evaluation, proximate composition, mineral content and quality parameters such as (texture, amino acid and protein quality (PQ) as biological value (BV%), essential amino acid index (EAAI%), and nutritional index (NI%)) of functional biscuit produced from replacement 30% of wheat flour by selenium sprouts for some cultivars of broad bean. The highest spread ratio was recorded in biscuit Se- sprout in Giza- 843 substituted which treated with plant and animal compost. All biscuits from three cultivars had significantly compared with wheat control in overall acceptability. The highest values for protein, ash, and crude fiber were recorded in the biscuit of Sakha-1 treated with plant compost. Mineral content Ca, K, Fe, Zn and Se was higher in biscuit, prepared with Sakha-1 fertilized plant compost, while biscuit, prepared with control for Giza- 843 was the highest value of Mg and Mn. The highest value of hardness was recorded in biscuit from Se- sprouts Giza-843 cultivar control. The highest values of EAA were recorded in improved biscuit with sprouts from Sakha-1 cultivar under two composts compared to wheat biscuit. The highest values for biological value(BV%) , essential amino acid index) EAAI%) and nutritional index) NI%) were recorded in biscuit of Sakha-1 under two composts. Concluded that suitability production functional Se- sprouts biscuit with highly EAA and PQ.
Key words: Se-germinates, broad bean, Sakha 1, Sakha 4, Giza 843, biscuits, nutritional value

1. Introduction

Legumes are essential to human nutrition in relation to their bioactive nutritional molecules.

Legumes and derived foods are rich in fiber, protein, low glycemic carbohydrates, vitamins and a few valuable phytochemicals, with significant biological activities that be key to human health. Bioactive peptides derived from legume proteins have many important roles as improving health compounds (especially interacting with disease-related enzyme amino acids). The presence of these bioactive peptides in legume crops can contribute to the quality of the diet. Legumes also have better nutritional qualities than wheat, but they do not contain sufficient sulfuric amino acids (methionine and cysteine). However, with a slight increase in one of these two amino acids, the tryptophan of legumes would become the next limiting amino acid in leguminous seeds. Thus, the enrichment of wheat flour with proteins not of wheat, also increases the quality of proteins by improving its amino acid profiles **[1, 2].** The nutrient content (proteins, carbohydrates and micronutrients) of legumes helps fight undernutrition, in particular protein-caloric malnutrition among children and nursing mothers in the developing world where cereal-based nutritional supplement with pulses is suggested as one of the best solutions for calorie protein deficiency. Furthermore, legumes play a role in preventing, improving and/or treating diseases such as diabetes mellitus, cardiovascular disease, cancer and lowering blood cholesterol **[3].** In Egypt, dry and green faba bean seeds (*Vicia faba* L.) are used as human food, so it is a permanent ingredient in most animal feeds **[4]**. Saline soils severely limit the production of leguminous crops. A variation in salinity tolerance has been reported in a number of legumes and can be used in the development of salinity tolerant cultivars. Faba beans are important amongst vegetables, and legumes are considered sensitive or moderately tolerant to salinity. Several mechanisms are developed by plants

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to induce tolerance to overcome harmful effects from salinity, including organic fertilizers and antioxidants **[5].**

Biscuits are convenient food products and the most popular baked goods consumed by virtually all levels of society. This is mainly due to the fact that they are ready to eat, of good nutritional quality and available in different varieties at an affordable price, including by children. These products are developed to implement formulations in nutritional terms, particularly linked to fiber and protein content and can be an interesting vehicle for beans as an ingredient **[6]**. There is a trend because of market competition and the growing demand for healthy foods to improve the nutritional value of biscuits and other products. Such effects are very often achieved by increasing the proportion of non-wheat commodities in basic recipes trying to raise the protein and mineral content of the biscuit for quality and availability **[7, 8].** Sprouting is done from the seeds when the seeds germinate. Sprouts are exceptional sources of protein, vitamins and minerals and contain them in a healthy way by maintaining important nutrients such as glucosinolates, phenolics and selenium-containing compounds. As sprouts are consumed at the early stages of growth, their nutrient levels remain very high. Bean Faba germinated contains large quantities of essential and non-essential amino acids **[9]**. In addition, anti-nutritional factors such as hemagglutinin, trypsin blockers and lipoxygenase decrease during germination **[10, 11].**

Selenium (Se), a vital micronutrient recommended for nutrition. for adults, 55 µg/day (the maximum tolerable level is 400 µg/day) is critical to human health. WHO has recommended 50-55g/day Se in human nutrition worldwide **[12, 13].** Se performs in variety of functions, its antioxidant and anticancerous properties are of primary concern for mankind **[14].** Seleno amino acids, selenocysteine (SeCys) and selenomethionine (SeMet) are responsible for most of the reported biomedical effects of Se in food **[15, 16].** Several studies have indicated that organic Se is typically less toxic and more bioavailable than inorganic Se **[17].**

Therefore, this study is designed to assess the suitability of biscuit produced with germs enriched with selenium faba bean flour for quality properties (chemically and technologically). Also intended for producing specific healthy dietary biscuits.

2. Material and Methods

The study experiments were carried out at the Bread and Pasta Research Department, Food Technology Research Institute, Agriculture Research Center, Giza.

2.1. 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) which treated with animal or plant compost within agriculture obtained from Leguminous Crops Research Department, Field Crop Institute, Agriculture Research Center, Giza. Where cultivars collected from two successive seasons of 2017 and 2018. The treatments were arranged in a split- plot design with four replicates as follows:

1. Control NPK recommended doses of nitrogen, phosphate and potassium, i.e., 45 Kg N per ha., 60Kg P_2O_5 per ha., and 120Kg K_2O per ha/fed. Using ammonium nitrate (33.5% N), using ammonium nitrate (33.5%N), Calcium super phosphate and potassium sulphate (Ammonium nitrate was add in four times at sowing date one dose and the last three doses every ten days after germination. Applied of potassium fertilizer was started at 30 days after sowing through 8 equal doses at 7- day intervals.
2. Plant compost ٥m^3/Fed (Total phosphorus(P_2O_5) % 1.08, Total potassium (%) 2.53].
3. Animal compost ٥m^3/Fed, Total potassium (%) 0.60[Total P_2O_5% 0.16].

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

2.2. Methods

2.3.1. Preparation enriched selenium broad sprouts flour

The seeds were germinated according to **[18]** as follow seeds were used in the preparation of Se-enriched biomass. Before germination, steeping process was performed with Se containing water solution with concentrations 20 mg Se /L for 72 hours at an ambient temperature of 25°C. The seeds were sprouted in trays on moist filter papers with the water solution with concentration 20mg Se/L, which, if needed, was added during germination. And then germinated seed samples were freeze-dried and All samples were stored in airtight containers and kept at 3–4°C until required.

2.3.2. Preparation of blends:

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

2.3.3. Preparation of biscuit

Biscuits made according to the previous method which described by **[19]** as follow biscuits were prepared as following: sugar (23%), butter (23%), flour (53%), (1%) baking powder, (0.25%) vanillin and (18%) water were used. Fat (butter), sugar and vanillin were mixed in a dough mixer using the flat beater for 1min., then scraped down and continued to mix for 3min at high speed. Flour and baking powder were added to the mixture and mixed at low speed. Dough was sheeted to 3.5 mm thickness with the help of an aluminum platform. Circles cut of past pieces were done by using of templates with an outer diameter of 52mm.The biscuits were baked at 170-180°C for 12min.The biscuits were allowed to cool for 60min at room temperature before sealed in metalized oriented polypropylene bags then stored at room temperature.

2.3.4. Physical analysis of biscuits

The average weight (g), diameter (cm), volume (cm3), Specific volume (cm3/g), thickness (cm) and the spread ratio (diameter/thickness) of biscuits were determined according to the method of **[20].**

2.3.5. Sensory evaluation

The sensory characteristics of biscuits were evaluated according to the method of **[21]** and were carried out by panel of ten experienced judges from the staff of the Food Tech. Res. Institute, Agric., Res. Center Giza, Egypt. Assigning scores for various qualities attribute such as: Color (25), taste (25), crust appearance (25), odor (25),and overall acceptability(100).

2.3.6. Proximate analysis

Moisture, protein, ash, crude fiber and ether extract were determined in biscuits product according to the methods described in **[22].** Total carbohydrates were calculated by difference.

2.3.7. Determination of minerals

Minerals contents (Ca, Mg, Mn, K, Fe, Zn, and Se) were determined using methods of **[22].** Perkin Elmer (Model 3300, USA) Atomic Absorption Spectrophotometer was used to determine these minerals.

2.3.8. Biscuit digestion for determination selenium

Samples were digested according to the method described by **[23]**as follow samples of Se-enriched sprouts (0.5g) were placed in 200×42-mm Pyrex digestion tubes. Concentrated HNO3 (5ml) were added and the mixture heated at 110°C using an electro thermal™ (Electro thermal Engineering Ltd., Essex, UK) heating mantle until foaming subsided. Concentrated per chloric (3ml) were added and heating at 110°C continued until the evolution of dense brown fumes had stopped. The temperature was then increased to 250°C and the digestion process monitored closely, as prolonged boiling or overheating of the digests might result in loss of volatile Se compounds. Digestion was complete when the dense white fumes HClO4 began to reflux in the upper neck of the tube and the solution stopped effervescing and boiled gently. Digested samples were cooled to room temperature. After cooling 1ml of concentrated hydrochloric acid were added and heated for 5min. then diluted to 50ml using deionized water. After digestion a Perkin-Elmer Analyst ™ 3300 atomic absorption spectrophotometer (Perkin-Elmer Life and Analytical sciences, Shelton, CT, USA) equipped with a deuterium background corrector were used. Alean blue flame were maintained using air: acetylene (3:1). The Se electrode less discharge lamp was operated at 200mA at wavelength of 196.0 nm and a spectral band of 2.0 nm. A calibration curve (10-50µg/L) Se were constructed after zeroing the instrument using 1% (v/v) HNO3. Each standard were analyzed in triplicate. Diluted digested samples were also analyzed in triplicate (Perkin Elmer).

2.3.9. 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 biscuit in terms of hardness (N), Adhesiveness (mj) and Resilience of the samples according to the method described by **[24].**

2.3.10. Determination of Amino Acids and nutritional quality

Amino acid compositions were determined according to the method described in **[22]**. Nutritional quality of the sprout biscuit samples was determined as the amino acid profiles. The essential amino acid index (EAAI) was calculated using the method cited by **[25]** according to following equation:

EAAI=

$$\sqrt[8]{\frac{(Lys\times Thryo\times Val\times Meth\times Isoleu\times Leu\times Phynl\times Hist)a}{(Lys\times Thryo\times Val\times Meth\times Isoleu\times Leu\times Phynl\times Hist)b}}$$

Where: [lysine, isoleucine, valine, threonine, leucine, phenylalanine, histidine and methionine] a in test sample and [lysine, isoleucine, valine, threonine, leucine, phenylalanine, histidine and methionine] b content of the same amino acids in casein as standard protein (%) **[26].** The nutritional index of the food samples was calculated using the formula below:

Nutritional index [%] = EAAI×% protein/100

The biological value [BV] was calculated according to **[27]** cited by **[28]** using the following equation:

BV (biological value) = 49.09 + 10.53 (PER)

The Protein Efficiency Ratio [PER] was estimated according to the regression equations developed by **[29]** as given below:

PER (Protein Efficiency Ratio) = - 0.684 + 0.456 (Leucine) – 0.047 (Proline) (g/100 g protein) for cereal

PER (Protein Efficiency Ratio) =-0.468+ 0.454 (LEU) – 0.105(TYR) for broad bean

2.3.11. Statistical analysis

Data of biscuit product (broad bean) was analyzed using F. test. LSD at 5% was calculated to determine the significance of differences among means according to **[30].**

3. Results and Discussion

3.1. Physical Characteristics of improved biscuit

Average values of physical characteristics of biscuits made from wheat flour and substituted with Se- sprouts bean cultivars flour are presented in Table (1). The result showed that the highest diameter (cm) of biscuit of substituted cultivars was recorded in Se-sprout of Sakha-1 substituted (5.95g). The Thickness (cm) had the higher value was recorded in biscuit from wheat flour 100% (control) and biscuit control for Se-sprout of Sakha-4 cultivar substituted (4.65 cm). The highest spread ratio was recorded in biscuit Se- sprout in Giza- 843 cultivar substituted (1.31 cm) which treated with plant and animal compost. The highest average weight (g) in biscuit from wheat flour 100% (control) followed by biscuit Se- sprout of Sakha- 4 cultivar substituted (45.17 g and 41.65 g) respectively, the highest volume and specific volume were recorded in biscuit Se- sprout of Sakha- 4 cultivar substituted which treated with animal compost (112.50 cm^3, 2.87 cm^3/g) respectively. This result may be due to additive Se- sprouts broad bean flour cultivars (at 30%), the spread ratio is the ratio between the diameter and the thickness and this parameter is important to evaluate the quality of the biscuits **[31].**

Table 1: Physical Characteristics of improved biscuits with enriched selenium sprout broad bean cultivars

Cultivars	Compost	Diameter (cm)	Thickness for five biscuit (cm)	spread ratio (diameter/thickness)	Average weight (g)	Volume (cm^3)	Specific volume (cm^3/g)
Flour wheat 100%		4.45	4.65	0.96	45.17	107.50	2.38
Sakha 4		5.40	4.35	1.24	39.88	107.00	2.69
Sakha 1		5.82	4.55	1.28	38.86	101.67	2.62
Giza 843		5.80	4.43	1.31	37.69	96.83	2.57
$LSD_{0.05}$		**0.02**	**0.09**	**0.02**	**0.65**	**2.39**	**0.09**
	Control	5.40	4.56	1.19	41.08	99.88	2.43
	Animal	5.28	4.45	1.19	39.75	105.00	2.65
	Plant	5.43	4.48	1.22	40.36	104.88	2.61
$LSD_{0.05}$		**0.06**	**0.03**	**0.02**	**0.37**	**1.43**	**0.05**
Flour wheat 100%	**Control**	4.45	4.65	0.96	45.17	107.50	2.38
	Control	5.70	4.65	1.23	41.65	100.00	2.40
	Animal	5.05	4.15	1.22	39.20	112.50	2.87
Sakha 4	**Plant**	5.45	4.25	1.28	38.79	108.50	2.80
	Control	5.75	4.55	1.26	39.69	98.50	2.48
	Animal	5.75	4.55	1.27	36.85	102.00	2.77
Sakha 1	**Plant**	5.95	4.55	1.31	40.03	104.50	2.61
	Control	5.70	4.40	1.30	37.82	93.50	2.47
	Animal	5.85	4.45	1.31	37.80	98.00	2.59
Giza 843	**Plant**	5.85	4.45	1.31	37.45	99.00	2.64
$LSD_{0.05}$		**0.11**	**0.08**	**0.04**	**0.79**	**3.01**	**0.10**

There was an indication of the viscous property of the paste and influenced by the recipe, the ingredients, procedures and conditions used in biscuit production **[32]**. Biscuits with high spread ratio values are better **[33].** Specific volume of biscuits slightly increased with the incorporation of Se- sprouts bean flour, which was mainly attributed to the gradual increase in volume and decrease in weight. The decrease in weight was possibly due to low oil absorption capacity (OAC) of the chickpea flour **[34].**

3.2. Sensory Evaluation of improved biscuit

Mean sensory attribute scores for improved biscuits assessed are set out in Table (2). The result showed that the mean scores by the panelists for all biscuits obtained from three cultivars at substitute (30%) had significant difference at 5% comparing with biscuit (100% wheat 72% ex. rate) in acceptance degrees, expect odor. Also, the differences between organic applications (plant and animal) were significant in all properties. Whereas biscuits produced from cultivars incorporating with treatment compared control (100% wheat flour) experienced the smallest significant difference in overall acceptability. Additional crust appearance not recorded significant difference in all biscuit. On the other hand, the sensory results indicated that control biscuit had the highest overall acceptability score follow by biscuit from substituted Se- sprout Sakha- 1 cultivar treated with compost plant (99.60 and 99.20) respectively. This results agreement with **[35]** they found that addition germinated faba bean Giza 843 variety at percent 30% improvement overall acceptability for biscuit compared with wheat biscuit**. [36, 37, 38]** they stated that biscuits color becomes darker with higher levels of protein in the amino acid formulation of the proteins react with reducing sugars during baking in the reaction of Maillard. **[39]** reported that raw and sprouted bean meal could be incorporated up to 100% into the cake formulation without affecting their sensory qualities.

Table 2: Sensory evaluation of improved biscuits with enriched selenium sprouts broad bean cultivars

Cultivars	**Compost**	**Color (25)**	**Taste (25)**	**Odor (25)**	**Crust appearance (25)**	**Overall acceptability (100)**
Flour wheat 100%		25.00	25.00	24.80	24.80	99.60
Sakha 4		24.00	23.93	24.20	24.07	96.40
Sakha 1		24.87	24.33	24.47	24.53	98.20
Giza 843		24.53	24.07	24.40	24.27	97.13
$LSD_{0.05}$		**0.29**	**0.33**	**ns**	**0.59**	**1.49**
	Control	40.67	40.17	40.50	40.50	162.00
	Animal	41.00	40.50	40.58	40.58	162.50
	Plant	41.33	41.00	41.25	41.00	164.67
$LSD_{0.05}$		**0.23**	**0.29**	**0.24**	**0.26**	**0.61**
Flour wheat 100%	**Control**	25.00	25.00	24.80	24.80	99.60
Sakha 4	**Control**	23.80	23.80	24.20	24.00	96.20
	Animal	24.00	23.60	24.00	24.00	95.60
	Plant	24.20	24.40	24.40	24.20	97.40
Sakha 1	**Control**	24.60	24.00	24.00	24.20	96.80
	Animal	25.00	24.40	24.60	24.60	98.60
	Plant	25.00	24.60	24.80	24.80	99.20
Giza 843	**Control**	24.20	23.60	24.20	24.20	96.20
	Animal	24.40	24.20	24.00	24.00	96.20
	Plant	25.00	24.40	25.00	24.60	99.00
$LSD_{0.05}$		**0.45**	**0.57**	**0.69**	**ns**	**1.62**

3.3. Proximate Composition of Produced improved biscuit

The proximate composing of biscuits produced from substitute level (30%) of Se- sprouts broad bean cultivars are given in Table (3). The result showed that the proximate composition of biscuits at substitute level (30%) from Se- sprouts broad bean cultivars with significant differences. The highest values for protein, ash, crude fiber were recorded in biscuit Se- sprouts made from Sakha- 1 cultivar (10.23, 1.58 and 1.17%) respectively, while the highest value of ether extract was recorded in biscuit Se- sprouts made from Giza-843 cultivar. The highest value of carbohydrate was recorded in biscuit Se- sprouts made from Sakha- 4 cultivar. In the same table proximate composition for biscuit three cultivars incorporated with compost treatment and compared biscuit control showed that biscuit Se- sprouts Sakha- 1 cultivar treated with plant compost had highest value (10.48, 1.72, 1.23%) for (protein, ash, crude fiber) respectively and the highest value of ether extract was recorded in biscuit control made from wheat flour (100%). From table concluded that Se- sprouts for bean cultivars improve the protein composing. Additionally, the biscuit Se- sprouts for bean cultivars has been a way of improve protein-calorie malnutrition and as functional product.**[40]** reported that sprouts legumes are an excellent source of highly bioavailable protein and minerals. As well, **[41]** recommended that cereal flour was enriched in starch and low in protein and is used in making of bread, cakes and pastries; a possibility would be to replace 10 to 20% of this legume meal. Amino acids in legume flour would enhance the nutritional status of the cereal protein.

Table 3: proximate Composition of biscuits with enriched selenium sprout broad bean cultivars (on dry basis)

Cultivars	Compost	Protein	Ash	Crude fiber	Ether extract	Carbohydrate
Flour wheat 100%		9.74	1.11	0.69	17.63	70.83
Sakha 4		9.97	1.54	1.01	15.94	71.54
Sakha 1		10.23	1.58	1.17	16.37	70.64
Giza 843		9.83	1.49	1.01	16.65	71.03
$LSD_{0.05}$		**0.081**	**0.02**	**0.03**	**0.50**	**0.54**
	Control	9.82	1.37	0.94	16.50	71.37
	Animal	9.90	1.43	0.96	16.74	70.98
	Plant	10.10	1.49	1.02	16.71	70.68
$LSD_{0.05}$		**0.014**	**0.03**	**0.01**	**0.21**	**0.16**
Flour wheat 100%	**Control**	9.74	1.11	0.69	17.63	70.83
Sakha 4	**Control**	9.78	1.48	0.97	15.95	71.83
	Animal	9.86	1.57	0.98	16.32	71.28
	Plant	10.27	1.58	1.08	15.57	71.51
Sakha 1	**Control**	10.03	1.46	1.12	16.11	71.28
	Animal	10.18	1.56	1.18	16.24	70.85
	Plant	10.48	1.72	1.23	16.78	69.80
Giza 843	**Control**	9.75	1.43	0.97	16.31	71.56
	Animal	9.83	1.48	1.00	16.79	70.95
	Plant	9.91	1.57	1.08	16.86	70.59
$LSD_{0.05}$		**0.066**	**0.05**	**0.03**	**0.52**	**0.49**

3.4. Minerals content of improved biscuit:

Minerals involved in improved biscuit are found in Table (4). From results it can be noticed that the mineral content Ca, K, Fe, Zn, and Se was higher in the biscuit prepared with substitute Sakha-1 cultivar which fertilizer with plant compost (932.7, 760.1, 43.2, 17.7 and 7.1mg/100g) respectively, while the biscuit prepared with substitute control for Giza 843 cultivar was highest values of Mg and Mn (630.0 and 20.08 mg/100g) respectively. From table concluded that fertilizer plant compost improves mineral content due to raising mineral in humic plant, also germination with Se because of the release of mineral content in sprouts due to active enzymes.

These results agree with **[42]** who reported that increased mineral content such as (Fe, Ca, Zn) in gluten - free biscuits with increasing the level of white beans meal. **[43]** mentioned that calcium plays

a sessional role in blood coagulation, muscle contraction and some enzymes in metabolic processes. Magnesium in the diet influences the metabolism of calcium, potassium and sodium. It is important for bone health; is required as a cofactor for numerous body-level responses and critical for nerve and muscle conductivity **[44].**

3.5. Quality parameters of improved biscuit with selenium enriched sprouts broad bean cultivars

Data presented in Table (5) showed the effect of substitute enriched selenium broad bean sprouts cultivars on hardness improved biscuits. These results indicated that no high in value between treatment biscuits and control biscuit, while, the highest value of hardness (N) was recorded in biscuit from Se- sprouts Giza-843 control cultivars compared to all treatments. Also, all cultivars were recorded the lowest value for adhesiveness (mJ) and resilience. These results indicated that substituted at 30% for all Se-sprouts broad bean cultivars don't high effect on biscuit hardness, also raising protein content in cultivars. **[45]** reported that the sprouted flour biscuits were found to be further harder as compared to un-sprouted flour biscuits due to the free sugars available on sprouting.

Also, results in Table (6) presented other side quality parameters for improved biscuit, which amino acid content of improved biscuit from Se- sprouts broad bean Sakha cultivar treatment with two organic applications compared to biscuit control. The highest values of essential amino acid were recorded in improved biscuits with Se- sprouts from Sakha-1 cultivar under animal and plant compost compared to control biscuit. Improved biscuit from Sakha-1 cultivar under plant compost had the higher values of all essential amino acid except Phenyl alanine, Valine, Methionine and Cysteine. Additionally, the highest of non- essential amino acid recorded in improved biscuit from Sakha-1 cultivar treated with plant compost compared to biscuit control except glutamic, Aspartic and serine. From table concluded that proline was higher in broad bean as indicated that may be due to exposure to salt stress within agriculture period. Also, the amino acid as methionine and cysteine recorded highest in broad bean biscuit due to germination with Se- compound in sprout water. Similar findings were reported by **[46]** reported that sprouting caused an increase in the content of almost amino acids especially in pie prepared from green pea sprout flour except arginine and aspartic acid and these results were in agreement with **[47]** and **[48],** they found about similar results. Also results of protein quality of improved biscuit from Se- sprouts broad bean Sakha cultivar treatment with two organic applications were presented in Table (6). The percentage of total essential amino acid showed that the highest values were recorded in improved biscuit with Se- sprouts from Sakha-1 cultivar under plant compost

Table 4: Mineral content of improved biscuits with enriched selenium sprouts broad bean cultivars (mg/100g)

Cultivars	Compost	Ca	Mg	Mn	K	Fe	Zn	Se
Control (Wheat flour100%)		635.3	384.5	10.2	124.1	14.4	5.7	2.5
Sakha 4	Control	852.8	336.0	19.8	271.8	19.8	13.0	4.7
	Animal	862.6	336.6	20.0	272.0	19.9	13.2	4.9
	Plant	863.8	339.7	10.1	280.3	20.1	13.6	4.9
Sakha 1	Control	871.0	349.5	10.2	637.7	22.8	13.6	4.8
	Animal	905.8	350.8	11.8	619.2	23.4	15.2	6.4
	Plant	932.7	358.8	11.9	760.1	43.2	17.7	7.1
Giza 843	Control	875.7	630.0	20.8	323.2	20.8	13.3	4.5
	Animal	880.3	320.7	10.7	32.7	21.6	16.8	6.2
	Plant	882.2	322.7	11.0	495.5	22.0	17.7	6.6

Table 5: Texture analysis of improved biscuits with enriched selenium sprouts broad bean cultivars

Biscuits / Characteristics	Control (Wheat flour100%)	Sakha 4			Sakha 1			Giza 843		
		Control	Animal	Plant	Control	Animal	Plant	Control	Animal	Plant
Hardness (N)	16.03	13.37	11.81	15.47	16.24	13.54	15.08	7.92	12.73	12.05
Adhesiveness (mJ)	0.20	0.00	0.00	0.30	0.00	0.00	0.10	0.10	0.00	0.00
Resilience	0.03	0.23	0.08	0.02	0.03	0.00	0.02	0.05	0.00	0.00

Table 6: Amino acid composition of improved biscuits (g/ 100g protein)

Amino acids	Control bread	Sakha 1	
	Flour wheat 100%	Animal	Plant
Essential Amino Acid			
Lysine	1.64	3.15	3.24
Leucine	4.72	4.96	6.19
Phenyl alanine	5.85	7.25	3.83
Threonine	1.95	2.39	2.65
Isoleucine	2.57	2.48	3.54
Valine	3.29	4.96	4.42
Methionine	1.13	1.23	1.18
Cysteine	2.36	2.48	2.36
Tryptophan	1.11	1.23	1.48
Histidine	2.16	1.96	2.96
Tyrosine	1.95	2.48	3.44
TEAA	28.73	34.57	35.29
Non-Essential Amino Acid			
Glutamic	23.92	32.06	20.43
Aspartic	3.18	8.59	6.88
Proline	4.83	7.35	7.56
Arginine	2.36	4.39	4.81
Glycine	2.77	2.58	3.73
Alanine	3.29	4.58	4.72
Serine	2.98	4.29	3.44
TNEAA	43.33	63.84	51.57
TAA	72.06	99.41	85.86

TEAA= Total essential amino acid, **TNEAA=** Total non-essential amino acid, **TAA=** Total amino acid,

While Table (7) were presented other protein quality. The resulted indicated that improved biscuits with Se- sprouts from Sakha-1 cultivar under plant compost had highest values for percentage ratio of total essential amino acid (TEAA) to the total amino acids (TAA) (41.10%). From results an observation in TSAA (Meth. + Cys) showed that the highest level was found in improve biscuits with Se- sprouts from Sakha-1 cultivar under animal compost. Most of biscuit samples contain more Cys than Meth. **[46]** reported that many vegetables proteins contain substantially more Cys than Meth. In contrast animal proteins are low in Cys **[49].** Also, **[46]** reported that the present pea sprout pie sample results Cys/TSAA. Cys has positive effects on mineral absorption particularly zinc, it is responsible bioactivity process in human **[50].**

Most commonly used method for measuring protein quality is the protein efficiency ratio (REP), that is the weight gained by rats (bioassays) divided by the weight of protein consumed. Nowadays,**[51]** equations using amino acid (AA) practical and less expenses and time required for the assay test. Protein quality can be measured with protein efficiency ratio

(PER), biological value (BV %), essential amino acid index (EAAI %) and nutritional index (%) (NI). In Table (7) found that the values of PER, BV% and EAAI % and NI% of the improved biscuits with Se-sprouts from Sakha-1 cultivar under plant compost had highest value compared with other treatments (1.98, 70.87%, 69.94% and 7.43%, respectively) which found in reference casein **[51]. [29]** reported that protein-based food is in adequate when it's EAAI below 70% and useful since EAAI value is around 80%. Scientifically, it is well known that a protein-based food nutritional is a good nutritional quality when its biological values (BV) are high (70% to 100%). Wheat is a low in some essential amino acids, notably lysine. Therefore, the traditional wheat-based food product, e.g., biscuits are generally of poor nutritional quality for human and this could have been the reason for the high prevalence of the protein malnutrition among weaning aged children in developing countries, where cereals are solely used as complementary foods **[52 and 53].** These results were in accordance with those found in previous research works **[54 and 55],** who confirmed that faba bean protein had well-balanced essential amino acid profiles, as well as, Dwarf protein is are comparable with the highly rated proteins, such as casein, beef, and fish.

Table 7: Nutritional quality of improve biscuits (g/ 100g protein)

Parameters	**Control bread**	**Sakha 1**	
	Flour wheat 100%	**Animal**	**Plant**
		Protein quality	
TEAA/TAA %	39.57	34.78	41.10
TNEAA/TAA%	60.13	64.22	60.06
TEAA/TNEAA	0.66	0.54	0.68
TSAA (Meth. + Cys)	3.49	3.71	3.54
PER	0.96	1.52	1.98
EAAI %	56.53	68.04	70.87
BV %	64.57	65.10	69.94
Nutritional index %	5.51	6.93	7.43

TEAA=total essential amino acids, **TAA**=total amino acids, **TNEAA**=total non-essential amino acids, **TSAA=**total sulphur amino acids, **PER**= Protein Efficiency Ratio, **EAAI** =essential amino acid index, **BV**= biological value, (amino acids in casein as standard protein (lys: 7.09; Thero: 3.78; Val: 5.82; Meth: 2.57; Isoleu: 4.54; Leuc: 8.28; Phenyl: 4.55; Hist: 2.55)

4. Conclusions

The obtained results indicated that suitability used Se- sprouts broad bean flour; special Sakha-1 cultivar to substitute wheat flour at 30% in functional biscuit production. The healthy biscuit produced were improved protein, amino acid content, Se content, and quality parameters such as texture, essential amino acid, and nutritional quality which it used as healthy functional biscuit.

5. References

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