Preparation and Evaluation of Healthy Biscuits Using Germinated Wheat Flour and Germinated Pumpkin Seed Flour

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Abstract

The current study aimed to manufacture healthy biscuits by replacing local wheat flour (Bhouhouth class 22) Wheat flour 80% extraction rates (soft) with germinated wheat flour and germinated pumpkin seeds flour in the following proportions (5% germinated wheat flour and 5% germinated pumpkin flour) treatment A2 and (10% germinated wheat flour and 10 % germinated pumpkin flour) treatment A3, (15% germinated wheat flour and 15% germinated pumpkin flour) treatment A4 and (20% germinated wheat flour and 20% germinated pumpkin flour) treatment 5A respectively, in addition to the control treatment A1 (non- germinated wheat flour). The results of the chemical analysis showed an increase in the percentages of moisture, protein, Fat, ash and fiber in the different biscuit treatments compared to the control treatment and a decrease in the percentage of carbohydrates. The results showed an increase in the values of zinc, iron, phosphor, potassium, magnesium, sodium and calcium for the manufactured biscuits. The results also showed an increase in Fatty acids palmtic, stearic, oleic and linolenic to (18.57, 16.26, 58.3, 72.78) mg/100gm for A4treatment, as for amino acids, no values of aspartic acid were observed in the control treatment, which amounted to 3.1, 4.1 and 5.1 for each of the treatments A2,A3,A4 respectively. Also, the values of vitamin C in all biscuit treatments increased to (3.6, 5.2, 6.7) mg/100g, respectively, after it was 2.4 mg/100g in the control treatment, and the sensory evaluation showed that the treatment of A2, A3, and A4 was significantly ($p<0.05$) superior to A1 treatment (control); as for A5treatment, it got the lowest scores in the sensory evaluation due to the appearance of bitterness in the taste due to the polyphenols that became apparent when the replacement percentages increased, so it was excluded. As for the diffusion rate of biscuits, it increased with the increase in the replacement rates to reach the highest percentage for A5 treatment, which amounted to 7.4 compared to the control treatment 6.5, and through these results, it can be said that the biscuits produced are healthy biscuits due to their high content of the required nutrients.

Key Words: Healthy Biscuits, Wheat Flour, Pumpkin Seed Flour, Germination, Nutrient and Mineral Composition.

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Introduction

Germination is one of the simple techniques that increase the nutritional value of the different types of seeds due to physiological and chemical changes due to several changes in the chemical composition of the seed, such as an increase in the proportion of proteins, fibers, sugars and vitamins, increase in the bioavailability of mineral elements and an increase in the effectiveness of enzymes, including alpha-amylase enzyme [14].

In 2008 the American Association of Cereal Chemists (AACC) released a statement defining what could be marketed as sprouted whole grains:

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In essence, nutritive value of products made from sprouted grain must be comparable to a whole grain standard, the statement supports the sprouted grain industry, while ensuring/encouraging responsible production and marketing practices [2].

Enzymes activated during the germination process degrade starch and non-starch polysaccharides as well as proteins, leading to an increase in reducing sugars, soluble dietary fibres, peptides, and amino acids, [24]. Therefore, biochemical processes that occur during germination can generate biologically active components such as riboflavin, thiamine, biotin, pantothenic acid, niacin, vitamin C, tocopherols and increase their availability [32]Germination is a widely used process to improve nutritional value. And flavoring improves the production of food products[28]. Sprouts are rich sources of proteins, vitamins and minerals, and they contain important nutrients for maintaining health, such as glucosinolates, phenols and selenium, due to the consumption of sprouts at the beginning of the growth stage, as sprouts contain nutrients in very concentrated proportions, and phytochemicals, vitamins, minerals and amino acids are of high importance because they are the most beneficial for human health[8]. Studies have shown that germination increases the protein content in germinated wheat flour and germinated pumpkin flour. The reason can be attributed to the increase in free nitrogen for the activity of proteolytic enzymes after germination [38] There are several studies that fortified wheat flour with germinated seeds to produce baked products of high nutritional value. Used sprouted chickpeas in the cake industry [4], and indicated a significant increase in the content of ash, protein, Fat, and fiber for quick bread (Muffin) made when replacing wheat flour with sprouted fenugreek seeds by 9% [5]

Wheat belongs to the grass family Gramineae [6], and is of special importance because of its role as a basic food for human nutrition, and its combination with the rest of the various seeds and grains becomes of great economic importance in many countries of the world [35]. In terms of the cultivated area and the third place in terms of production, as wheat is a food commodity on which large segments of societies of different nationalities depend, and baking products are considered among the oldest foods as they fill the sustenance and cover some of the peoples' food needs, and local and international consumption, such as biscuits, cakes, bread of all kinds, pasta, noodles, and chips [38].

Pumpkin (Cucurbita) is a plant belonging to the Cucurbitaceae family. It is one of the most widely cultivated vegetables, but its seeds are disposed of as waste without recognizing their nutritional value. After salting and roasting [30]. However, the nutritional benefits of pumpkin seeds have attracted researchers' interest in them as a potential source of micronutrients, being an excellent dietary source of minerals mainly zinc, phosphorous, magnesium, potassium and selenium [40].The fiber in pumpkin seeds can prevent constipation, diabetes, and prolong Intestinal transit time, lowering blood cholesterol level and increasing satiety, pumpkin seeds can serve as a good source of Fats, proteins, carbohydrates and other nutrients that are important for maintaining good health, as pumpkin seeds have shown Pharmacological properties such as antidiabetic, antifungal, antibacterial, anti-inflammatory and antioxidant [37]. Adding pumpkin seeds is an easy and feasible way to enhance the nutritional value of foods and add variety to healthy snacks such as fortification of baked goods such as biscuits, cookies, pies and bread. Pumpkin seeds can also be used to fortify wheat flour to produce bakery products such as pastries with a unique and nutty taste [30].

Biscuits are one of the most popular snacks in most countries of the world due to their distinctive taste, ease of digestion, cheap price and long shelf life [33]. Biscuits are products that contain a high percentage of carbohydrates, Fats and calories, but are low in fiber, vitamins and minerals, making it unhealthy for daily use for all age groups [29]. Biscuit is a product made from wheat flour as an essential ingredient due to the high gluten content, but its nutritional value is low[33]. Eating healthy food is an important part of a healthy lifestyle and healthy nutritional practices must be educated from childhood [14], Eating the right food in quantity and quality ensures that a person obtains the basic and necessary elements for the performance of important vital and physiological processes such as growth and cellular construction [22]. that foods rich in polyunsaturated Fatty acids are of health importance due to their important impact on the development of the retina and brain in newborns as well as being mainly important in the prevention and treatment of chronic diseases, because poor foods Minerals, especially iron, calcium and zinc, have negative effects on human

health and may lead to anemia due to iron deficiency, rickets, osteoporosis and immune system diseases. Therefore, the current research aims to manufacture healthy biscuits from both germinated wheat flour and pumpkin seed flour [14].

Materials and Methods

Wheat Germination Process

Local wheat (Bhouhouth class 22) was obtained from the 2020 harvest from the Ministry of Agriculture / Agricultural Research Department. The grains were purified from foreign matter, and then washed with distilled water several times at room temperature, and then the wheat grains were soaked for 12 hours. The ratio of water to wheat kernels was (1:3), that is 3 times the weight of the seed. The soaking water was drained and the soaked seeds were washed more than once using distilled water to prevent the growth of microorganisms. (Microbes) During germination, the grains were wrapped with a cotton cloth to activate germination, then the grains were spread in steel trays in the form of one layer after the trays were brushed with two layers of cotton cloth, germination was carried out at room temperature under the dark, the grains were sprayed 2-3 times with distilled water within 24 hours to enhance germination[41]. The grains and their germinated parts were dried at a temperature of (±40)°C to bring the moisture content of wheat grains to (10-11)% and to make the aroma pleasant. The germination process continued for 24 hours so that the length of the sprout did not exceed grain length [2].

Pumpkin Seed Germination Process

The pumpkin seeds of Iranian origin with the brand (Khalis) were obtained in 2020 filling from the local commercial markets, the empty and broken seeds and foreign materials were removed, then the seeds were soaked with water for 12 hours, and the ratio of water to squash seeds was (1:3), 3 times the weight of the seed, then the soaking water was drained The soaked seeds were washed more than once using distilled water to prevent the growth of microorganisms (microbes) during germination. The seeds were wrapped with a cotton cloth to activate germination. The seeds were then spread in steel trays in the form of one layer after the trays were brushed with two layers of the cloth. Cotton, germination was carried out at a temperature of (25) ° C under the dark, the seeds were sprayed 2-3 times with distilled water during the day to promote germination, covered and left for 2-3 days with regular spraying during it, the seeds were dried With the parts growing in the air after covering it with a cloth[9].

Grinding Wheat Grains

The types were ground with a laboratory mill from Buhler Company of Swiss origin [1]. In the laboratories of the Quality Control Department/General Grain Processing Company with an extraction rate of 80%. Temperature (40) °C, to reach a humidity of (10%) for 22 hours [3].

Biscuit Preparation

The biscuits were prepared in the Grain Laboratory, Department of Food Science in Agricultural Engineering/University of Baghdad. The ingredients used in making biscuits are in Table No. (1), according to the standard method in AACC (2000), American Grain Chemists Association numbered (5-10) with a slight modification of the roasting temperature.

Table 1. Ingredients used in the manufacture of laboratory biscuits

Ingredients	Amount
Wheat Flour 14%	225
Sugar powder (g)	130
Butter (ml)	64
Table salt	2.1
Baking Soda	2.5
Water	16 ml
Glucose solution (8.9 g / 150 ml water)	33 ml

Method

The dry ingredients (sugar, baking soda, salt, butter) were first mixed in the bowl of the stand mixer for three minutes only to form a soft cream, then water and glucose solution were added, and the mixture was mixed for two minutes, and finally, the flour was mixed for one additional minute. It was noticed that a non-cohesive dough was formed in the form of small blocks that are spread on fat paper between two glass plates with a thickness of 6 mm with a wooden roller, then cut the dough in the middle into 6 pieces with a biscuit cutter with a diameter of 60 mm, and after removing the edges, roasting was done in the oven at a temperature of 175° C for 10 minutes, then left to cool at room temperature, and after 60 minutes, the biscuit

spread coefficient was calculated from the product of dividing the rate of Width of 6 pieces, by the rate of Thickness of 6 pieces.

Calculation of Thickness, Width and Diffusion Coefficient of Laboratory Biscuits

The diameter of the biscuits: The diameter of the biscuits was measured by taking 6 balls stacked one next to the other and measuring their diameter twice with a difference of 90 degrees and according to the average, The thickness of the biscuits: placing 6 biscuits on top of each other and their height was measured, and the average height of one disk was calculated, Diffusion Ratio: dividing the diameter of the biscuit by its thickness[13].

Sensory Evaluation of Laboratory Biscuits

The biscuits were evaluated by (10) specialized assessors in the College of Agriculture, Department of Food Sciences, based on qualitative characteristics (outward appearance, softness, color, taste and texture [13].

Analytical Methods

Nutritional Evaluation

The moisture content was estimated using the standard method of the American Association of Cereal Chemists in (2010) No. (44-19.01) using an oven at a temperature of 135 ° C until the weight is stable. The total nitrogen ratio was estimated using the microkeldahl named after the scientist (keldahl) using the standard method of the American Association of Cereal Chemists No. (10.01-46) in 2010. The sample is digested with concentrated sulfuric acid. The ash was estimated for flour types using the standard method of the American Grain Chemist Association No. (03.01-08) in 2010 using an incineration oven at a temperature of 550°C. The total carbohydrate was calculated by the difference method. Total carbohydrate (%) = 100– [crude protein (%) + crude fat (%) + crude moisture (%)crude fiber (%) crude ash (%).

Estimation of Amino Acids

Content of non-germinated and sprouted amino acids flour was measured in vitro by DPPH assay as described before[18] with some modifications, Acidic flour sample was analyzed by heating (0.2) g of a sample in (0.2) ml of (6) hydrochloric acid The acid is placed in a closed and vacuum tube, placed in the furnace at A Temperature (110) degrees Celsius for (24) hours. The Types were removed from the oven after completion appropriate time, and then filtered through filter paper (0.8)µm and wash with (50) ml deionized water. The The resulting part that is washed is concentrated by spin drying evaporate at (50)°C, add (10) ml of deionized water and The evaporator is again at (50)°C, then (3) ml of (0.02) C. add hydrochloric acid again. Then it was injected into an amino acid analyzer Shaft dimensions were (4.6 mm* 150 mm) with OPA. Flow rate (2) ml/mind.

Estimation of Mineral Elements

The mineral elements were estimated, which included (iron, zinc, phosphorous, potassium, magnesium, selenium and calcium). In the Ministry of Science and Technology/Environment and Water Department/ for biscuit types [17], the absorbance was measured using an atomic absorption device of type 7000 (SHEMADZU AA).

Vitamin C Estimation

Ascorbic acid was estimated as mentioned[19], and absorbance was measured for all types using UV-visible spectrophotometer to determine the concentration of ascorbic acid.

Fatty Acid Estimation

The sample was prepared according to the method of, where gas chromatography and flame ionization detection (GC-FID) method was developed for the quantitative analysis of Fatty acids USP-NF. Fatty acids were separated using a DB-FFAP (nitro-terephthalic acid modified polyethylene glycol) GC capillary column (30 m × 0.32 mm ID) with a total run time of 20 min[42].

Results and Discussion

Chemical Composition of Biscuit Types

The results in Table No. (2) showed a gradual decrease in carbohydrate values from 70.78% in the control treatment to reach 63.49%, 57.68% and 52.23% in the biscuit treatments A2, A3 and A4, respectively. The results of this study are close to Bello[15], as the percentage of carbohydrates decreased, and it was 61.81% in the control treatment and decreased to 54.93%, and the decrease in the carbohydrate content was attributed to an increase in the addition of germinated pumpkin seed flour[12].

The results of Table (2) indicate a gradual increase in the values of moisture, protein, Fat and fiber in the biscuit treatments after it was in the control treatment (2.4, 11.31, 11.45, 1.5, 2.56)%, respectively. The moisture percentage in the biscuit treatments A2, A3, and A4 increased to 3.5%, 3.9%, 4.2%, respectively, the results of this study came close to what was mentioned by[36]. when studying the chemical composition of wheat biscuits fortified with flour of germinated peas, where the control treatment (100% wheat flour) reached 2.45% and for the fortified biscuits 3.60 %. It was also found the moisture content of refined wheat biscuits fortified with (yam flour 70%) increased to 3.53%[39], after the percentage in the control biscuits (refined wheat flour 100%) was 3.43%, due to the increase in the protein content in the produced biscuits. The protein-rich flour has the ability to crystallization and water storage capacity, and these properties are desirable in different foods to increase their storage period[20]. The results of the same table also indicated a high percentage of protein reaching (13.91, 15.12, 17.62) % in treatments A2, A3 and A4, respectively, compared to the control treatment (11.31)%. The results of the study came close to what was found [39], as the percentage of protein in biscuits with control treatment (100% refined wheat) increased from 7.14% to 7.60%, in biscuits fortified with 70% yam flour) with 10% of germinated pea flour, the percentage of protein in the control treatment was 11.90%, and it rose to 12.03%, that baked goods rich in proteins are of great importance to overcome global malnutrition. In pumpkin seeds as well as the effect of the germination process, which gives a positive indication of the increase in the nutritional value of the biscuits produced.

Table 2. Chemical composition (%) of biscuits types (on dry weight bases)

Composition (%)	A1	A2	A3	A4	SD (P≤0.05)
Moisture	2.4	3.5	3.9	4.2	1.59
Protein	11.31	13.91	15.12	17.62	3.55
Fat	11.45	12.89	14.93	16.26	2.94
Fiber	1.5	2.4	3.6	4.3	1.82
Ash	2.56	3.81	4.77	5.39	1.95
Carbohydrates	70.78	63.49	57.68	52.23	6.28

Means of triplicate determinations ± S.D. with different superscripts on the same column are significantly different.

Fig. 1. Developed germinated wheat and germinated pumpkin seed flour biscuits

Estimation of Mineral Elements for Biscuit Types

Table (4) shows the values of the mineral elements that included (zinc, iron, phosphorous, potassium, magnesium, selenium, calcium) for the laboratory biscuits. (0.27, 1.0, 30.2, 210, 758, 99.2) mg / 100 g, and the highest values for treatment A4 reached the percentage of replacement (15% of germinated wheat flour and 15% of germinated pumpkin flour) amounting to 4.6, 36.9, 2.7, 0.54, 125.6, 869 and 248 mg / 100 g, respectively. The results of this study came close to what[30] observed in his study, as the mineral content improved when fortifying whole wheat flour with germinated pumpkin flour for biscuit mixtures, as the values of calcium, magnesium, zinc, iron, potassium and phosphorous increased as they increased. The fortification rates reached in the control treatment (46.38, 28.22, 9.65, 10.52, 53.38, 54.56) mg/100g respectively, then increased when fortifying the biscuits by 10%, 20% and 30%, as the calcium percentage reached 49.16, 56.54, 69.04). mg/100 g respectively, magnesium 30.61), 33.39 and (36.36 mg/100 g respectively), zinc (11.43, 13.54, (15.69 mg/100 g respectively), iron (12.64, 15.57, 17.51) mg/100 g respectively, and potassium (55.50, 58.67, 61.45 mg/100g respectively, and phosphorous (56.47, 58.41, 61.39) mg/100g respectively.

Table 4. Mineral elements content, mg/100g of biscuits types (on dry weight bases)

Minerals mg/100g	A1	A2	A3	A4	SD (P≤0.05)
Zinc	2.0	2.8	3.4	4.6	1.04
Iron	30.2	32.5	34.8	36.9	3.46
Phosphorous	1.0	1.5	2.2	2.7	0.884
Potassium	0.27	0.36	0.48	0.54	0.201
Magnesium	99.2	104.8	114.7	125.6	16.42
Sodium	758	812	841	869	41.57
Calcium	210	228	237	248	29.62

Means of triplicate determinations ± S.D. with different superscripts on the same column are significantly different.

Fatty Acid Content of Biscuit Types

Table (5) showed the high values of Fatty acids (palmitic, stearic, oleic, linolenic, linolenic) for the laboratory biscuits were in the control treatment (15.24, 11.45, 19.8, 41.93, 5.89) mg/100g, respectively, while in the A2 treatment it amounted to (16.99, 12.89, 2.63, 55.48, 6.22) mg / 100 g, respectively, and in treatment A3 it reached (17.23, 14.93, 40.8, 58.09, 7.44) mg / 100 g, respectively, while treatment A4 had the most high values, reaching (18.57, 16.26, 58.3, 72.78, 8.97) mg / 100 g, respectively. germination could lead to an increase in the proportion of palmitic, stearic, oleic and linolenic[34], Fatty acids in wheat fortified with flour germinated quinoa seeds during 24 hours, which were in the control treatment (12.2, 1.3, 29.9, 32.7) mg/100g, respectively. The values increased after germination to reach (19.8, 2.0, 34.0, 33.8) mg/100g, respectively, as they mentioned. They are rapidly metabolized to recombine the membrane bound lipid in the early germination period.

Table 5. Fatty acids content mg / 100 g for the biscuits types (on dry weight bases)

Sample Type / Fatty Acid (mg / 100g)	A1	A2	A3	A4	SD (P≤0.05)
Palmitic	15.24	16.99	17.23	18.57	2.06
Stearic	11.45	12.89	14.93	16.26	2.86
Oleic	19.8	32.6	40.8	58.3	6.19
linolenic	41.93	55.48	58.09	72.78	6.46
Linolenic	5.89	6.22	7.44	8.97	1.87

Means of triplicate determinations ± S.D. with different superscripts on the same column are significantly different.

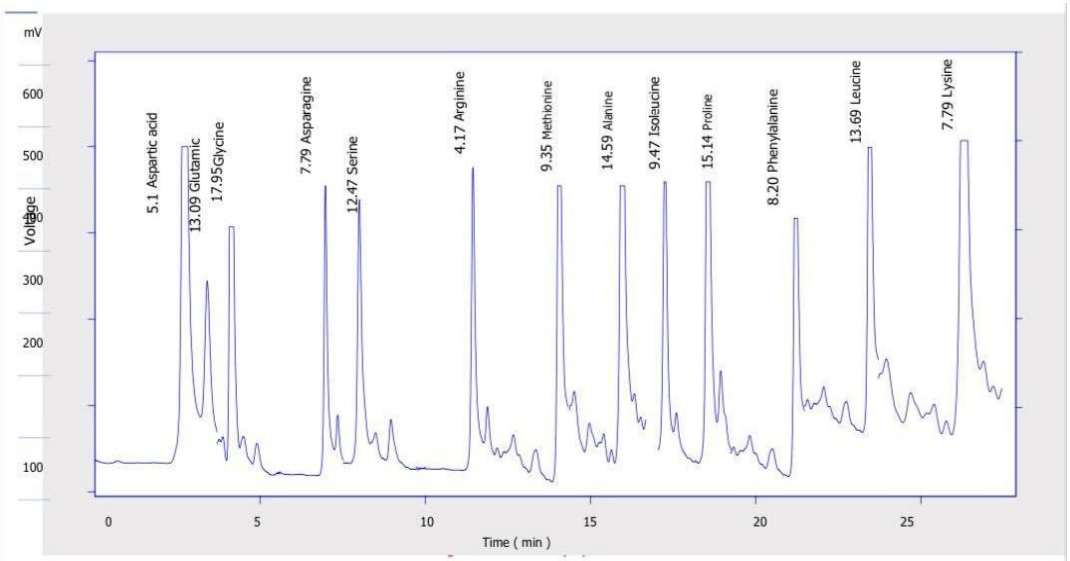
Amino Acid Content of Biscuit Types

Table (6) shows an increase in the values of essential amino acids (lysine, leucine, Phenylalanine, isoleucine, methionine) and nonessential amino acids (glutamic, glycine, serine, arginine, Alaninee, proline, asparagine) for laboratory biscuits by increasing the replacement ratios, and they were in the control treatment A1 (1.15, 7.15, 2.66, 2.89, 1.14, 12, 8.6, 2.48, 3.69, 3.60, 3.79, 1.13) mg/100g respectively, while no value of aspartic acid was recorded in the control treatment, in treatment A2 amounting to (2.17, 10.48, 3.89, 4.58, 3.76, 13.03, 10.84, 5.48, 3.69, 7.49, 8.46, 2.19) mg / 100 g, respectively, and aspartic acid reached 3.1 mg / 100 g, and in the treatment A3, the proportion of amino acids was (4.59, 13.96, 5.47, 6.59, 5.57, 13.06, 14.98, 8.41, 4.15, 11.48, 12.25, 4.59) mg/100g, respectively, and aspartic acid recorded a value of 4.1 mg/100g. As for the A4 treatment, it was the most concentrated values in amino acids, reaching (7.79, 16.58, 8.20, 9.47, 9.35, 13.09, and 17.95, 12.47, 4.17, 14.59, 15.14, 7.79) mg / 100 g, respectively, and aspartic acid recorded a value of 5.1 mg / 100 g.

Table 6. Amino acid content (mg/100g) of biscuits types (on dry weight bases)

Sample Type / Amino Acids mg/100g	A1	A2	A3	A4	SD (P≤0.05)
Lysine	1.15	2.17	4.59	7.79	1.88
Leucine	16.58	10.48	7.15	13.69	2.07
Phenylalanine	2.66	3.89	5.47	8.20	1.36
Isoleucine	2.89	4.58	6.59	9.47	1.67
Methionine	1.14	3.76	5.57	9.35	1.72
Aspartic	---	3.1	4.1	5.1	1.26
Glutamic	12.70	13.03	13.06	13.09	NS1.05
Glycine	8.6	10.84	14.98	17.95	2.68
Serene	2.48	5,48	8.41	12.47	2.94
Arginine	3.69	3.69	4.15	4.17	0.33
Alaninee	3.60	7.49	11.48	14.59	1.46
Proline	3.79	8.46	12.25	15.14	2.09
Asparagine	1.13	2.19	4.59	7.79	1.78

Means of triplicate determinations ± S.D. with different superscripts on the same column are significantly different.



No	Reten. Tame (min)	Response	Amount [ug/gm.]	Peak Type	Calculation	Compound Name
1	3.78	1458.9	5.1	Order	Calibration Carve	Aspartic acid
2	4.18	1698.5	13.09	Order	Calibration Carve	Glutamic acid
3	4.92	1854.1	17.95	Order	Calibration Carve	Glycine
4	7.50	1639.8	7.79	Order	Calibration Carve	Asparagine
5	8.19	1528.9	12.47	Order	Calibration Carve	Serine
6	10.49	1635.9	4.17	Order	Calibration Carve	Arginine
7	14.77	1895.4	9.35	Order	Calibration Carve	Methionine
8	15.37	1652.9	14.59	Order	Calibration Carve	Alanine
9	17.46	1625.8	9.47	Order	Calibration Carve	Isoleucine
10	18.58	1698.7	15.14	Order	Calibration Carve	Proline
11	22.36	1524.7	8.20	Order	Calibration Carve	Phenylalanine
12	24.28	1369.8	13.69	Order	Calibration Carve	Leucine
13	27.36	1589.5	7.79	Order	Calibration Carve	Lysine
	TOTAL					

Fig. 2. Chromatographic analysis of Amino Acids type A4 by HPLC technique

Vitamin C Content of Biscuit Types

Table (7) shows that the vitamin C content of the laboratory biscuits increased with the increase in the replacement rates. The highest percentage of increase was in the A4 treatment, which amounted to 6.7 mg/100 g compared to the control treatment, which was 2.4 mg/100 g, while in the two treatments A2 and A3 it amounted to (3.6, 5.2) mg/100 g. respectively. indicated that the content of vitamin C in green and black bean sprouts increased from 13.5 mg/100 g to 24.0 mg/100 g and from 10.3 mg/100 g to 21.3 mg/100 g compared to raw seeds[25], especially after germination for 5 days. That vitamin C accumulates in newly germinated seeds because most seeds contain little vitamin C or be unavailable before germination, moreover, l-galactono-gamma-lactone dehydrogenase (GLDH) is a key enzyme in the biosynthesis of ascorbic acid and helps stimulate The oxidation of L-galactono-1,4-lactone to ascorbic acid, it was also observed that the activity of these enzymes increases during soybean germination in parallel with the increase in the content of ascorbic acid.

Table 7. Vitamin C content (mg/100g) of biscuits types (on dry weight bases)

Sample Type	Vitamin C (mg/100g)
A1	2.4
A2	3.6
A3	5.2
A4	6.7
SD (P≤0.05)	1.652

Means of triplicate determinations ± S.D. with different superscripts on the same column are significantly different.

Thickness, Width and Diffusion Coefficient Values for Biscuit Types

Table (8) shows an increase in the diffusion coefficient of laboratory biscuits, as the A5 treatment recorded the highest percentage of 7.4, and because of the appearance of bitterness in the taste due to polyphenols, it was excluded. As for the treatment of A2, A3 and A4, the prevalence rate reached (7, 6.6 and 7.3) respectively compared to the control treatment (100%). wheat flour) 6.5. The superiority of biscuits produced from germinated wheat with a replacement ratio of 15% and 20% over the (control treatment of 100% wheat) [26].

Table 8. Values of thickness, width and spread coefficient of standard biscuits made from the types of the biscuit types (on dry weight bases)

Property	A1	A2	A3	A4	A5	SD (P≤0.05)
Width(cm)	42.3	43.2	44	44.5	44.9	2.96 NS
Thickness (cm)	6.5	6.2	6.1	6.6	6	0.603
Diffusion Rate	6.5	7	6.6	7.3	7.4	0.589

Means of triplicate determinations ± S.D. with different superscripts on the same column are significantly different.

Conclusions

Biscuit made in the lab from replacing wheat flour with germinated wheat and pumpkin flour improved the nutritional value of the biscuits, as the nutrients were increased from protein and fiber in addition to the mineral elements, amino acids and Fatty acids. The concentration of vitamin C and the mineral content of zinc, iron, phosphorous, potassium, magnesium, selenium and calcium as well as an increase in the amino acids of lysine, Phenylalanine, histidine, methionine and Fatty acids such as oleic, linolenic and linolenic whose values increase for the better after germination. Germination also limits the addition of sugar and helps give a desired color and new flavor due to the increase in the amount of reducing sugars associated with Maillard reactions. Thus, biscuit is a healthy product useful for young and old.

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