IMPROVING NUTRITIONAL AND QUALITATIVE PROPERTIES OF WHEAT BREAD BY USING MALLOW (*MALVA NEGLECTA* L.) LEAVES POWDER

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ABSTRACT

This study was investigates the effect of adding different concentrations (1, 2, 3, 4, 5, 6, 7, 8) % of mallow (*Malva neglecta* L.) leaves powder (MLP) to wheat bread mix on nutritional and qualitative properties of the obtained bread. Results of the chemical composition based by dry matter, moisture, ash, protein, fat, and carbohydrates for wheat flour and mallow leaves powder were 87.4, 12.6, 0.65, 10.5, 1.25, 75% and 96.2, 3.8, 7.90, 12.70, 1.60, 74.20 %, respectively. The study included nine treatments (T1, T2, T3, T4, T5, T6, T7, T8, T9), where T1 was the control treatment. During the fermentation period, dough mass was increased to its maximum value, T1 recorded the lowest height. The addition of (MLP) led to a slight increase in the specific volume of (T2, T3, T4, T5, T6), and this may be due to the increase in the proportion of polysaccharides in the mallow plant, while the specific volume began to decrease significantly in treatments (T7, T8, T9). Each of (T7, T8, and T9) showed significant differences as compared with the control treatment (T1) for the characteristics of color of crust, symmetry of form, evenness of bake, grain, color, texture of crumb, aroma, and taste. There were no significant differences between (T2, T3, T4, T5, T6) compared with T1. The results indicate that the consumer accepted T2, T3, T4, and T5 treatments as well as T1. GC analysis showed the presence of phenolic compounds in mallow leaves powder, such as phenol, 2-chlorophenol, 2-methyl phenol, 4-methyl phenol, 2-nitrophenol, 2,4-dimethylphenol, benzoic acid, 2, 4- Dinitrophenol (0.150, 0.036, 0.03, 0.127, 1.360, 0.042, 0.002, 5.552 mg\100g) respectively.

Key word: mallow vegetative parts chemical composition, Sensory evaluation, Specific volume, Fermentation .

تحسين الخصائص الغذائية والنوعية لخبز القمح باستعمال مسحوق أوراق الخباز (.*MALVA NEGLECTA* L)

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المستخلص

تبحث هذه الدراسة تأثير إضافة تراكيز مختلفة (1، 2، 3 ، 4 ، 5 ، 6، 7، 8)٪ من مسحوق أوراق الخباز (*Malva neglecta* L) إلى خليط خبز القمح على الخصائص الغذائية والنوعية لخبز القمح. كانت نتائج التركيب الكيميائي للمادة الجافة والمتمثلة بالرطوبة والرماد والبروتين والدهون والكاربوهيدرات لدقيق القمح ومسحوق أوراق الخباز (87.4 ، 12.6 ، 0.65 ، 10.5 ، 1.25 ، 75٪) (96.2 ، 3.80، 7.90 ، 12.70 ، 1.60 ، 74.20٪) بالتتابع. اشتملت الدراسة على تسعة معاملات (T1، T2، T3، T4، T5، T6، T7، T8، T9) ، حيث مثلت المعاملة T1 معاملة السيطرة. لوحظ خلال فترة التخمير ، زادت كتلة العجين إلى أقصى حد لها ، وسجلت T1 أقل زيادة. أدت زيادة نسب إضافة (MLP) إلى زيادة طفيفة في الحجم النوعي في المعاملات (T2، T3، T4، T5، T6) ، وقد يكون ذلك بسبب زيادة نسبة السكريات في نبات الخباز . ثم بدأ الحجم النوعي في الانخفاض بشكل ملحوظ في المعاملات (T7، T8، T9) ، وقد يكون ذلك بسبب انخفاض نسبة الغلوتين في هذه المعاملات. أظهرت المعاملات (T7، T8، T9) اختلافات معنوية مقارنة بمعاملة السيطرة (T1) لخصائص لون القصرة، تناسق الشكل، تناسق عملية الخبيز، نسجة اللب ولون اللب وقوام اللب والطعم والرائحة. وكانت الفروق معنوية بين المعاملات (T2، T3، T4، T5، T6) مقارنة بالمعاملة T1. أشارت النتائج إلى أن تقبل المستهلك للمعاملات T2 و T3 و T4 و T5 بالإضافة إلى T1. أظهرت نتائج التحلل الكروماتوكرافي الغاز السائل وجود المركبات الفينولية في مسحوق أوراق الخباز حيث وجدت مركبات الفينول ، 2–كلوروفينول ، 2–ميثيل فينول ، 4–ميثيل فينول ، 2–نيتروفينول، 2،4–داي ميثيل فينول، حمض البنزويك ، 2 ، 4–داينيتروفينول بتراكيز (0.150 ، 0.036 ، 0.03 ، 0.127 ، 1.360 ، 0.042 ، 0.002 ، 5.552 ملغم / 100 جم) على التوالي.

الكلمات المفتاحية: التركيب الكيميائي للأجزاء الخضرية للخباز، التقييم الحسي، الحجم النوعي، التخمير.

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INTRODUCTION

Herbs and plants were used for thousands of years as traditional medicines to treat numerous diseases as anti-carcinogenic, antibacterial, anti-inflammatory, anti-atherosclerotic, antitumor , and antimutagenic. Medicinal plants are a good source for a wide variety of natural products, such as the phenolic and flavonoid compounds which are very interesting for their antioxidant properties (3 ; 13 ; 4). Bread which made from refined white flour is a product with low concentrations of antioxidants, and due to its wide consumption all over the world, it can be considered an interesting way to supply it with functional supplements (13 ; 28). Dziki et al., (12 ; 4) reviewed current trends in enhancing baked wheat products by adding raw materials rich in phenolic antioxidants, such as grains, spices, herbs, fruits, and by-products of the food industry. However, few studies have focused on enriching these products with green portions of vegetables. Moreover, several studies have not taken into account consumer acceptance of fortified bread. Nowadays, there is an increasing global demand for foods fortified with natural antioxidants to improve overall health and reduce the risk of chronic diseases caused by oxidative stress. Foods rich in antioxidants play an essential role in preventing cardiovascular diseases, cancers, infections, and problems caused by skin aging. Plants are an inexhaustible source of functional and bioactive compounds and have been used for thousands of years for their preservative properties and also to enhance the flavor and color of food. Currently, incorporating these plants into the traditional food industry has become an interesting approach, which has greatly improved the potential of this food as a "preventive model" for disease prevention (3 ; 13 ; 17). *Malva neglecta* L. (family-Malvaceae) is an annual, biennial, or perennial herb plant which is commonly known as cheese weed mallow. This genus is spread throughout the temperate, subtropical, and tropical regions of Africa, Asia, and Europe .M. neglecta has been widely used in several parts of the world for curing diverse diseases such as inflamed purulent wounds, boils, and swellings. A dried powder of leaves and roots is used to clean wounds and sores. Leaves and stems of *M. neglecta* contained different amounts of phenols, flavonoids, saponins, alkaloid, resin, and tannin (antioxidant potential). Moreover, this plant is used for the treatment of inflammation, pain, and liver injuries (3 ; 13). Wild mallow was used in the Middle East on a large scale as a source of food in times of war and periods of austerity and was known as Khubeiza or Tula in Arabic, and it is used as the main ingredient in a traditional Arabic dish called with the same name; and also in salads, soups and other dishes by the local Arab population. It is used in Turkey as a vegetable in various forms such as stuffing the leaves with bulgur or rice or using the boiled leaves as a side dish. The soaked (cooked) leaves are used to treat dysentery, constipation, and fever. Besides, the cataplasm of leaves is also used in the treatment of painful wounds and skin ulcers, this vegetable contains many important nutrients such as essential minerals, n-3 and n-6 fatty acids, and various terpenes with valuable biological properties. Moreover, this vegetable possesses important antioxidant activity thus can be used as a natural inexpensive and abundant source during the winter season to reduce cellular oxidative damage (24). In the present study, mallow leaves powder (MLP) was used to evaluate their effect as a functional ingredient for enhancing the Nutraceutical properties of baked wheat products.

MATERIAL AND METHODS

Mallow leaves powder (MLP) preparation ; The whole plant of mallow was harvested in February 2019 from the area of the University of Baghdad (Baghdad, Iraq). The leaves were separated, washed well, then dried in the shade for ten days at room temperature, then grind using a household grinder (Chinese type Cia Tronic). The powder was passed through a sieve No. 70 (250 µm) and stored in polythene bags at room temperature under a dry condition until use it (13).

Bread(loaf) preparation; The bread-making were done using the straight dough according to AACC method No. 10-10 B (1 ; 21) with a slight modification. The bread formula for each loaf was included 100 g wheat flour, 1 g yeast, 1 g salt, 5 g sugar, 3 g fat, and an adequate amount of water to obtain dough of optimum consistency. The bread-making procedure was included mixing, at low speed for 2 min followed by a 9 min rapid mixing using spiral arm mixer, and a fermenting time of 120 min at 36◦C and 70% relative humidity (r.h.) and baking for 20 min at 210◦C. in a convection oven. Baked loaves were cooled down at room temperature for 60 min, wrapped in a plastic film, and then stored at room temperature (20˚ C), below the treatments used in this study;

T1: Only the main components. .
T2: The main ingredients with 1% MLP.
T3: The main ingredients with 2% MLP.
T4: The main ingredients with 3% MLP.
T5: The main ingredients with 4% MLP.
T6: The main ingredients with 5% MLP.
T7: The main ingredients with 6% MLP.
T8: The main ingredients with 7% MLP.
T9: The main ingredients with 8% MLP.

Sensory evaluation of bread (loaf) ; The sensory properties (color, odor, taste, texture, and overall acceptability) of loaves were evaluated according to Almhyawi, (6) method by (8) panelists.

pH measurement of flour and dough; AACC method 02-52 (1) was adopted by mixing 10 g of flour or dough with 100 ml distilled water (pH 7), then homogenized by German Heidolph Made at 2600 speed (r.p.m.) for 2 minutes and left for 5 minutes, then pH was measured.

Chemical analysis of MLP ; All treatments and MLP were studied using the standard method AACC (1), (19-44), (30-25), (46-11), (01-8). Total carbohydrate was calculated by difference.

Estimation of phenolic compounds

Sample Preparation; Five grams of MLP was extracted by maceration using 100 ml of methanol and 0.1 % HCl. The mixture was placed on a magnetic stirrer for one hour, and separated using a centrifuge at 4000 r.p.m. for 10 minutes. The supernatant was concentrated using a rotatory evaporator, filtered and injected into the GC device.

Bread staling tests

Determination of the moisture content of bread crumb and crust; Crumb and crust moisture was measured adapting AACC (1) , (44-19) by taking 3gm bread crust and crumb individually, both were dried under 105˚ C until constant weight.

Determination of crumb swelling power (SP); SP of the crumb was measured according to Al-jelawi(5), two gm of bread crumb mixed with 10 ml distilled water (d.w.) for 30 min., then placed in a test tube for centrifugation at (3000× g / 5 min), the strength of swelling power determined according to the following equation:

The crumb swelling power (SP) = D-(A+B) / B

A= centrifuge tube weigh.

B = sample weigh.

D= residues tube weigh.

Determination of crumb sediment volume in aqueous suspension (CVS) ; CVS was evaluated according to Al-jelawi(5), 5 gm of bread crumb was mixed with 50 ml d. w. for 15 min, then placed in the graduated cylinder and left for 2.5 hours until crumb portions were settled and leachate becomes clear, the CVS recorded in cm^3.

Determination of antioxidant activity

DPPH Radical-Scavenging Activity (RSA)

The RSA was measured according to (27) with some modulations. One ml of the sample (4 mg/ml) was mixed with 1 ml of DPPH solution (0.1 M). The mixture kept at the dark place at room temperature for 30 minutes and then centrifuged at 10,000 g for 5 min. The absorbency was measured at 517 nm, and the percentage of the scavenging activity was calculated according to the following equation

Radical Scavenging activity A = [C – (B–A)/ C] x100

A= Spectrophotometer reading of the tested sample at517 nm wavelength.

B = the absorbance of the control at 517 nm (prepared by mixing 1 ml of ethyl alcohol with 1 ml of the sample under study).

=C = reading of the positive control at 517 nm (obtained from mixing 1 ml of DPPH with 1 ml of distilled water).

Statistical analysis ; Statistical Analysis System (SAS) (26) was used for the analysis of data, to study the effect of different treatments in the studied traits in full randomized design (CRD). The differences between mean were compared with the least significant difference (LSD).

RESULTS AND DISCUSSION

Chemical composition of flour and mallow leaves powder: Table 1 show the chemical components percentages of the flour and mallow leaves powder. The percentage of moisture in the flour (Besler Brand) was 12.6%, which is within the favorites range of bakeries (11.5 - 15.2%) and it helps in storing flour without damage. Moisture is an important factor in determining the quality of the flour and its water absorption. Almhyawi,(6) found that the moisture content in Iraqi wheat was (13.40%). The protein content was 10.5 %. These results were consistent with Al-jellawi (5) Who found that the percentage of protein in the Iraqi wheat was (10.27%) and Hussain et al,(15) Who found the protein content in the Iraqi wheat (8.54-11.40%). Fakhfakh et al,(13) indicated that the percentage of soft wheat protein ranged between 9-12%. The protein content of grains is a quality characteristic, and it the basic criteria for the quality of wheat grains, which depends mainly on the genetic factors of class, species, climatic, and agricultural conditions prevailing during the growth. The same table showed that the fat percentage was (1.25%). Several studies have confirmed the importance of flour fat in bread making and the rheological properties of the dough, despite their low concentration compared to other flour ingredients (13). Ash percentages for flour samples were 0.65%, which is similar to that report by Pozrl *et al.* (25). Ash content is associated with the quality of the milling process and it is a strong indicator for flour color and purity. The efficiency of the milling process is determined by knowing the flour content of ash which is mainly associated with the amount of bran in the wheat grain, (usually 0.4-2.0%, calculated based on 14% moisture) (14). Pozrl *et al.*,(25) found that the percentage of carbohydrates in wheat were (65-75%), which is identical to what found in the flour of the treatments under study. Results are shown that the total chemical composition of the powder of mallow's leaves represented by, dry matter, ash, proteins, fat, and carbohydrates were (98.40, 7.90, 12.70, 1.60, 74.20%) respectively. Dry matter content depends on the structure of the plant tissue; for this reason, diversity in the dry matter content for different plant species is expected (19). Some authors reported that the dry matter content of mallow species were 23.1 % in *M. sylvestris* (22) and 20.3- 20.9 % in *M. neglecta* (8). Total ash contents may be thought of as an indicator of mineral contents in the plant materials (23). The highest total ash content was determined in *M. neglecta* (15.6 %). A similar result was found for *M. sylvestris* (20.0 %) by Kaya *et al.* (18) and *M. sylvestris* (17.14 %) by Civelek and Balkaya, (9).The amount of nitrogen in plants is very important and varies according to plant type, climate, and soil kind(19). Özbucak *et al.*, (22) reported that the amount of protein in *M. sylvestris* is 3.5%, While Tunçtürk *et al.* (29) indicated that the percentage of nitrogen in *M. sylvestris* was 1.37%. Proteins in plants have determined the food value. Some authors reported that the protein contents of mallow species were (16.86, 22.33, 26.02, 26.25 - 28.38 %) in types of mallow (*M. neglecta*, *M. sylvestris*, *M. neglecta*, and *M. sylvestris*) respectively (8; 9; 22; 30). This result is similar to our study. The ascorbic acid content of the mallow (*M. neglecta* species) was (83.5 mg/100g), while Demir, (11) found that the amount of vitamin C for the same type was 53.62 mg / 100 g. the other studies found that the amount of ascorbic acid of wild edible plants was more than what was mentioned above (23).

Table 1. Chemical composition of mallow leaves powder and flour

Chemical Composition	Dry matter (%)	Moisture (%)	Ash (%)	Fiber (%)	N (%)	Protein (%)	Fat (%)	CHO. (%)
Wheat Flour	**87.40**	**12.60**	**0.65**	**0.70**	**1.85**	**10.50**	**1.25**	**75.00**
***M. neglecta* leaves**	**96.20**	**3.80**	**7.90**	**6.35**	**2.00**	**12.70**	**1.60**	**74.20**

Determination of flour and dough Ph: Table 2 shows pH values in the flour and dough. The pH values for flour, mallow leaves powder were (5.71, 5.58) respectively. The results indicated that the highest pH values were seen at the preparation time, and ranged from 5.57-5.62, then these values decreased with the progress of the fermentation process for all treatments. Treatment (T3) shows the lowest value after 2 h. where it was (5.24) as compared with the other treatments, which reached to 5.41, 5.29. 5.24, 5.38, 5.39, 5.40, 5.43, 5.38, and 5.4, respectively, at the end of the fermentation processes. The decreasing in pH values may be due to the yeast's ability to ferment the sugars available in the flour, as well as the added sugar. The pH values of the prepared bread for the treatments were (5.42, 5.40, 5.38, 5.38, 5.36, 5.36, 5.35, 5.34, and 5.34) respectively, and the differences among them were not significant, this is an expected results. Özer and Aksoy, (23) found that the pH of M. neglecta was 6.5, while the pH value of *Malvella sherardiana* was (4.6).

Table 2. pH values in the flour and dough of treatments under study

Treatment	pH			
	Dough Zero Time	Dough after 2 h.	Bread	L.S.D
T1 (main components)	5.62	5.41	5.42	0.288 NS
T2 (with 1% MLP)	5.58	5.29	5.40	0.216 NS
T3 (with 2% MLP)	5.56	5.24	5.38	0.298 NS
T4 (with 3% MLP)	5.62	5.38	5.38	0.392 NS
T5 (with 4% MLP)	5.60	5.39	5.36	0.326 NS
T6 (with 5% MLP)	5.59	5.40	5.36	0.291 NS
T7 (with 6% MLP)	5.57	5.43	5.35	0.276 NS
T8 (with 7% MLP)	5.62	5.38	5.35	0.362 NS
T9 (with 8% MLP)	5.60	5.40	5.34	0.377 NS
Flour (Besler) (pH=5.71)	----	----	----	-
M. neglecta (pH=5.71)	----	----	----	-
L.S.D.	0.297 NS	0.352 NS	0.384 NS	-

The effect of mallow leaves powder on the dough volume during the fermentation process

Table 3 shows the volume of the dough inside the fermentation vessels, the results indicate that the volume of the dough at zero time was 100 cm^3 for all treatments. During the fermentation process, the dough mass increased to its maximum value by the end of fermentation process (after 2 hours). Treatment T1 recorded the lowest height, it reached 550 cm^3 as compared with the other treatments (T2, T3, T4, T5, T6, T7, T8, T9) which reached to (600 - 570 - 575, 570, 570, 565, 560, and 560 cm3) respectively. During the fermentation stage, yeast causes some changes in the dough such as fermentation of sugary materials, production of some products such as carbon dioxide, alcohol, organic acids, and esters, changes in the pH level, and softening the gluten (2). These elements lead to a complex system. Carbon dioxide production leads to a rise in the dough, this depends on the effectiveness of the yeast and the availability of the basic materials, and absence of growth inhibitors (14 ; 16).

Table 3. The volume of the dough during the fermentation process

Treatment	Dough volume at zero time	Dough volume after 2 H.	L.S.D.
T1 (main components)	100	550	84.52 *
T2 (with 1% MLP)	100	600	102.95 *
T3 (with 2% MLP)	100	570	81.29 *
T4 (with 3% MLP)	100	575	84.36 *
T5 (with 4% MLP)	100	570	81.29 *
T6 (with 5% MLP)	100	570	81.29 *
T7 (with 6% MLP)	100	565	75.66 *
T8 (with 7% MLP)	100	560	78.02 *
T9 (with 8% MLP)	100	560	78.02 *
L.S.D.	-	58.41 NS	--------

The effect of mallow leaves powder on the weight, size, and specific volume of the manufactured bread

Table (4) shows the effect of adding mallow on the weight, size, and specific volume of the manufactured bread. The results indicate an increase in the weight of experimental bread with an increase in the percentage of added mallow powder. This increase was not significant except for treatments T8 and T9 compared with the other treatments. It has been noticed that there were non-significant differences among the treatments (T1, T2, T3, T4, T5, T6, T7) in size character of the bread, as their values were (700, 740, 730, 730, 725, 700 and 680) cm^3, respectively. While T8 and T9 treatments showed significant differences as compared with the other treatments, their values were 550 and 520 cm^3. These results were reflected on the values of the specific volume (cm^3 / g) for the bread produced from the flour under study, as the differences were not significant among the specific volume values of all treatments except for the two treatments T8 and T9. The use of mallow leaves powder resulted in a steady decrease in the specific volume at all levels of addition. This decline is due to the decrease in the percentage of gluten in the mallow powder leaves mixtures. The results in Table 4 regarding the volume and specific volume of the bread agreed with the data reviewed by Fakhfakh et al, (13), who found a significant decrease in bread volume due to the increasing substitution level, which was expected because dough expandability was significantly reduced due to addition.

Table 4. Weight, size and specific volume of the experimental bread

Treatment	Weight (g)	Volume (cm^3)	Specific volume (cm^3/g)
T1 (main components)	150.25 A	700 A	4.65 A
T2 (with 1% MLP)	148.67 A	740 A	4.93 A
T3 (with 2% MLP)	150.43 A	730 A	4.85 A
T4 (with 3% MLP)	153.05 A	730 A	4.77 A
T5 (with 4% MLP)	152.80 A	725 A	4.74 A
T6 (with 5% MLP)	151.20 A	700 A	4.63 A
T7 (with 6% MLP)	151.44 A	680 A	4.49 A
T8 (with 7% MLP)	165.91 B	550 B	3.31 B
T9 (with 8% MLP)	163.42 B	520 B	3.34 B
L.S.D.	11.382 *	86.93 *	0.633 *

Sensorial characteristics of the experimental bread

Table 5. shows the internal and external characteristics of manufactured bread, including the specific volume, the color of the crust, evenness of bake, the symmetry of form, aroma, taste and the color, the grain and the texture of the crumb. It is noted that, the use of mallow leaves powder led to an insignificant increase in the specific volume in the treatments (T1, T2, T3, T4, T5, and T6), and this may due to the increase in the percentage of polysaccharide in the mallow plant. The specific volume began to decline significantly in the treatments (T7, T8, and T9) and this may be due to a decrease in the percentage of gluten in the mixtures of mallow leaves powder. T7, T8, and T2 treatments showed significant differences as compared with control treatment (T1) in the characteristics of the crust color , symmetry of form, aroma, taste, and the grain, color, and texture of the crumb. While non-significant differences were observed among treatments (T2, T3, T4, T5, and T6) with treatment T1 . It is noticed from the results that the receptivity to T7, T6, T8, and T9 treatments is lower as compared with T1, and this may be due to the decline in the sensory characteristics of the product because mallow leaves powder is not suitable for making bread alone. It can be concluded from the results above that 4% of mallow leaves powder can be added successfully to wheat flour to produce high quality bread while maintaining a high degree of consumer acceptability

Table 5. Evaluation of internal and external sensory characteristics of experimental bread

Parameters of quality	Scores	T1	T2	T3	T4	T5	T6	T7	T8	T9	L.S.D.
Specific Volume	30	28a	30a	29a	28 a	27 a	25 ab	22 b	20 b	19 b	6.31 *
Color of crust	10	8 a	8 a	8 a	8 a	7 a	7 a	6a b	5 b	4 b	2.58 *
Symmetry of form	5	4 a	4 a	4 a	4 a	4 a	3 ab	3a b	2 b	2 b	1.84 *
Evenness of bake	5	4 a	4 a	4 a	4 a	4 a	4 a	4 a	3 a	3 a	1.02 NS
Grain of crumb	10	8 a	8 a	8 a	7 a	7 a	6 a	6ab	5 b	5 b	2.07 *
Color of crumb	10	9 a	8 ab	8 ab	8 ab	7abc	6bc	6bc	5 c	5 c	2.38
Texture of crumb	10	8 a	8 a	8 a	7 ab	7 ab	7 ab	5 b	5 b	5 b	2.19 *
Aroma and taste	20	16 a	16 a	15 a	15 a	14 ab	12 ab	11 b	11 b	10 b	3.63 *
Total	100	85 a	86 a	80 a	82 a	78 a	67 b	68 b	56 c	53 c	8.04 *

T1: Only the main components. T2: The main ingredients with added 1% Mallow leaves powder (MLP). T3: The main ingredients with added 2% MLP. T4: The main ingredients with added 3% MLP. T5: The main ingredients with added 4% MLP. T6: The main ingredients with added 5% MLP. T7: The main ingredients with added 6% MLP. T8: the main ingredients with added 7% MLP. T9: The main ingredients with added 8% MLP. * ($P \leq 0.05$).

Antioxidants in mallow powder

Table 6 represent the phenolic compounds in the mallow leaves powder, as they were phenol, 2-chlorophenol, 2-methyl phenol, 4-methyl phenol, 2-nitro phenol, 2,4-dimethylphenol, benzoic acid, 2, 4- Di nitro phenol at a concentration (0.150 , 0.036 , 0.03 , 0.127 , 1.360 , 0.042 , 0.002 , 5.552) (mg\100g), respectively. Eight types of standard phenolic solutions (available) were used. ==== Beghdad, (7), when studying the concentration of phenolic compounds and carotenoids in the leaves, stems, and seeds of the mallow plant (*Malva sylvestris* L.) indicated that the concentration of phenolic compounds was higher in the extracts isolated from the leaves A high percentage of total polyphenols was found in mallow leaves being 24,123 ± 0.718mg GAE/g (31). While Conforti *et al.,* (10) indicated that the phenolic content of mallow leaves was in the range of 28 ± 0.35 mg chlorogenic acid equivalent / g of dry matter. Whereas other authors found total phenolic 0.84% as Gallic acid (13; 27). From the above results, it can be concluded that the leaves of the mallow plant can be a promising source for fortifying bread with phenolic compounds. The antioxidant activity (DPPH Radical-Scavenging Activity (RSA)) was measured, and it was found that its value was (44.97%) for mallow leaves extract, which is a good percentage.

Table 6. Phenolic compounds available in the mallow leaves powder

Phenolic Compounds	Concentration (mg/100g)
Phenol	0.150
2-cloro phenol	0.036
2- methyl phenol	0.003
4- methyl phenol	0.127
2- nitro phenol	1.360
2,4- di methyl phenol	0.042
Benzoic acid	0.002
2,4- dinitro phenol	5.552

Effect of mallow leaves powder (MLP) on bread staling: Tables 7 shows the effect of adding 4% mallow leaves powder (MLP) on bread staling during different storage period at (20◦C). The moisture content in the fresh bread is distributed continuously between the crumb and crust of the bread. During bread storage, the moisture is migrated from the crumb to the crust . With gradual loss of crumb moisture and reduction of soluble starch (re-crystallization of starch), which is usually "high" in fresh bread, the staling of bread increases with the aging of the product (5 ; 6 ; 16). Table 7 elucidated gradual increase in the moisture content of the bread crust, during the storage period in both treatments, and reached the highest value after72 hours of storage in T2, being (26.15%). The results of statistical analysis showed a significant differences ($p \leq 0.05$) between both treatments through the storage periods. The swelling power of crumb for both treatments were significantly different , and decreased gradually through the storage period. This could be attributed to the starch's re-crystallization (It is a situation where the starch becomes less soluble in water)(5; 20). A gradual decrease in the volume of sediments were observed for both treatments as the storage period proceeded. The statistical analysis ($p \leq 0.05$) showed a significant differences in the volume of crumb sediment in the aqueous suspension during the storage periods of both treatments. It is noteworthy that the amount of soluble starch was decreases a long with the storage time of product storage, this is due to the re-crystallization of starch which causes a reduction in starch water solubility. From the results of the same table, we note that adding mallow leaves powder to bread has led to an increase in its shelf life due to the high percentage of saccharides in this plant.

Table 7. Effect of mallow leaves powder (MLP) added to wheat bread mix on bread staling

Treatments	Moisture content (%)			
	24 h.	48 h.	72 h.	LSD value
T1 (Control)	20.08	21.28	22.48	*1.13
T2 (with 4% MLP)	24.80	25.18	26.15	*1.12
LSD value	*2.83	*2.46	*2.13	--------
Treatments	The volume of sediment (cm^3)			
T1 (Control)	6.50	6.50	6.25	*1.136
T2 (with 4% MLP)	8.50	7.75	6.63	*1.183
LSD value	*1.59	*1.34	*1.72	--------
Treatments	The swelling power			
T1 (Control)	0.510	0.374	0.324	*0.196
T2 (with 4% MLP)	0.691	0.582	0.427	*0.246
LSD value	*0.137	*0.097	*0.087	--------

CONCLUSION

Eating foods rich in antioxidants, in a balanced context of the diet, is associated with the prevention of many degenerative diseases. Thus, improving the functions and sensory properties of traditional foods such as bakery products is an interesting approach with respect to actual consumer demand. Mallow (M. neglecta) is an important medicinal herb and functional food, it is rich in bioactive compounds and presenting important biological properties. At a fortification level of 4%, it can be used as a functional ingredient to enhance the nutritional potential of wheat bread without altering its organoleptic capacity.

REFERENCES

1. AACC.2010. A proved method of American Association of Cereal Chemists .St. Paul, Minnesot. U.S.A. pp. 215

2. Abadi, F.A. and J.M. Nasir. 2019 . Effect of wet gluten addition on stalin characteristics of barley bread. Iraqi Journal of Agricultural Sciences. 50(1):390-397.

3. Al-badri R. H. 2012. Extraction, Partial Purification and Characterization of Peroxidase from *Malva neglecta*. A Thesis Submitted to the College of Science-University of Baghdad as a Partial Fulfillment of the Requirements for the M. Sc. Thesis in Biotechnology.20-31. Pp. 53-56

4. Albandary, N. A. 2023. Phenolic compounds content, antioxidant, antibacterial and antifungal activities of red onions skin. Iraqi Journal of Agricultural Sciences, 54(4), 1050-1057. https://doi.org/10.36103/ijas.v54i4.1794

5. Al-jelawi, H. J. R. 2017. Using Transglutaminase in Improving Local Wheat (AL-Rasheed Variety) Bread quality. A Thesis of Master of Science in Food Science. In The Department of Food Science. Collage of Agriculture.Baghdad University.Iraq. Pp.78-86

6. Almhyawi, E. K. H.2018. Using Wheat Phytase in Reducing the Level of Phytate in Bread and Biscuit Mmade from Local Whole Wheat Flour. A Thesis of Master of Science in Food Science. In The Department of Food Science. Collage of Agriculture. Baghdad University. Iraq.34-56

7. Beghdad, M. C.; C. Benammar,;F. Bensalah, ; F. Z. Sabri.; M. Belarbi and F. Chemat. 2014. Antioxidant activity, phenolic and flavonoid content in leaves, flowers, stems and seeds of mallow (*Malva sylvestris* L.) From North Western of Algeria. African Journal of Biotechnology, 13(3): 486-491

8. Ceylan, F., and E. Yücel. 2015. Düzceve Çevresinde Gıda Olarak Tüketilen Yabani Bitkilerin Tüketim Biçimlerive Besin Öğesi Değerleri. AKÜ FEMÜBİD 15, 1-17

9. Civelek, C., and B. Balkaya. 2013. The nutrient content of some wild species used as vegetables in Bafra plain located Black Sea Region of Turkey. Eur. J. Plant Sci. Biotechnol. Veg. Sci. Biotechnol. Turk., 7 (1), 62-65

10. Conforti, F.; S. Sosa; M. Marrelli; F. Menichini; G. A. Statti; D. Uzunov; A. Tubaro; F. Menichini and R. D. Loggia. 2008. In vivo anti-inflammatory and in vitro antioxidant activities of Mediterranean dietary plants. J. Ethnopharmacol. 116, 144-151

11. Demir, H. 2018. A Comparative study of chemical compound of some edible plants of the Eastern Anatolia Region of Turkey. Journal of Nutritional Health Sciences, 1(9), 1-12

12. Dziki, D.; R. Rozyło; U. Gawlik-dziki and M. Świeca. 2014. Current trends in the enhancement of antioxidant activity of wheat bread by the addition of plant materials rich in phenolic compounds. Trends Food Sci Tech 40, 48–61

13. Fakhfakha N.; J. Hamida; J. Mourad; R. Mostafa; B. Lassaad; M. A. Ayadi; N. Moncef and Z. Nacim. 2016 . The mallow, *Malva aegyptiaca* L. (Malvaceae): Phytochemistry analysis and effects on wheat dough performance and bread quality. LWT - Food Science and Technology, http://dx.doi.org/10.1016/j.lwt.2016.10.015

14. Hammood E.K and J. M. Nasir. 2017. The effect of fermentation and baking processes on the phytate degradation during the process of manufacturing whole wheat flour bread. Iraqi journal of market research and consumer protection. (ijmrcp), i.s.s.n:2071-3894, vol 9 no 2 .doi prefix:10.28936

15. Hussain, L. A.; M. S. Hamdalla. and S. A. Yousif. 2023. Study baking quality of some bread wheat genotypes under water stress. Iraqi Journal of Agricultural Sciences, 54(4), 996-1007. https://doi.org/10.36103/ijas.v54i4.1788

16. Jasim, A. S., and J. M. Nasser. 2023. The functional properties of chemically and enzymatically modified wheat gluten. Iraqi Journal of Agricultural Sciences, 54(5), 1279-1291. https://doi.org/10.36103/ijas.v54i5.1826

17. Jassim Al-khafagi, M. F., and D. Y. Mohammed. 2023. Comparison phytochemical compounds from two different solvents of crude capparis spinosa extracts. Iraqi Journal of Agricultural Sciences, 54(5), 1234-1242. https://doi.org/10.36103/ijas.v54i5.1818

18. Kaya, I.; N. Incekara; and Y. Nemli. 2004. Ege Bölgesi'nde Sebze Olarak Tüketilen Yabani Kuşkonmaz, Sirken, Yabani Hindiba, Rezene, Gelincik, Çoban Değneğive Ebegümecinin Bazı Kimyasal Analizleri. Yüzüncü Yıl Üniversitesi, Ziraat Fakültesi, Tarım Bilimleri Dergisi, 14(1), 1-6

19. Kibar, B. And S. Temel. 2016. Evaluation of mineral composition of come wild edible plants growing in the eastern Anatolia Region Grasslands of Turkey and consumed as vegetable. J. Food Process. Preserv., 40(1), 56-66

20. Nashmi, R. G., and J. M.Naser. 2023. Extending the shelf-life of wheat bread using pentosanes extracted from barley. Iraqi Journal of Agricultural Sciences, 54(4), 939-949. https://doi.org/10.36103/ijas.v54i4.1783

21. Nashmi, R. J., and , J. M. Naser. 2022. Improving the rheological and qualitative properties of bread wheat by barley-extracted pentosanes. Iraqi Journal of Agricultural Sciences, 53(5), 1212-1222. https://doi.org/10.36103/ijas.v53i5.1635

22. Ozbucak, T. B.; O. E. Akcın and S. Yalcın. 2007. Nutrition contents of the some wild edible plants in Central Black Sea Region of Turkey. Int. J. Nat. Eng. Sci., 1, 11-13

23. Özer, M. O. And M. Aksoy. 2019. Mineral composition and nutritional properties of *Malva neglecta* and *Malve llasherardiana* consumed as vegetable in Central Black Sea Region of Turkey. Turkish Journal of Food and Agriculture Sciences. 1(1): 18-23

24. Paul D. 2016. A Review on Biological Activities of Common Mallow (*Malava sylvestris* L.). Vol 4, Issue 5, 2016 ISSN - 2321-550X

25. Požrl T.; M. Kopjar; I. Kurent; J. Hribar; A. Janeš and M. Simčič . 2009. Phytate degradation during bread making: The influence of flour type and bread making procedures. Czech J. Food Sci., 27:29–38

26. SAS. 2012. Statistical Analysis System, User's Guide. Statistical. Version 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA

27. Shamurad, H.Y.; M.J. Khadom ; F.A. Haider and K.A. Shakir.2019. Evaluation the antioxidant activity of sesame coat and sesame cake extracts. Iraqi Journal of Agricultural Sciences. 50(3):776-782

28. Sura, J. B. And I. H. H. Al-Hilfy. 2022. Effect of foliar application of moringa leaves extract on yield and quality of bread wheat. The Iraqi Journal of Agricultural Science, 53(2), 315-321. https://doi.org/10.36103/ijas.v53i2.1538

29. Tunçtürk, M.; M. Tunçtürk; T. Eryiğit and A. R. Kaya. 2018. Mineral and Heavy Metal Constituents of Three Edible Wild Plants Growing in Van Province. Iğdır Üni. Fen Bilimleri Enst. Der., 8(2), 293-298.

30. Yucel, E.; A. Tapırdamaz; I. Y. Şengün; G. Yılmaz and A. Ak. 2011. Determining the usage ways and nutrient contents of some wild plants around Kisecik Town (Karaman /Turkey). Biol. Divers. Conserv., 4(3), 71-82

31. Zohra, S.F. ; B. Meriem and S. Samira. 2013. Some extracts of mallow plant and its role in health. APCBEE Procedia 5:546-50.