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Study of the Nutritional, Sensory and Antioxidant Properties of Bread Fortified With Almond Flour in Different Proportions

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Abstract: The study was conducted in the laboratories of the Faculty of Agriculture, Tikrit University, where bread fortified with almond flour was manufactured in different proportions (5-25)%, as differences were observed between the proportions of the ingredients, the humidity increased by 29.83% in treatment A1 and decreased in treatment A5 to be 13.09%, as for the percentage of fat, protein, ash, and fiber, the highest percentage was recorded in treatment A4 to be (1.53 ،**2.90** ،**12.78** ، **1.80**)% respectively, but these percentages decreased in the A5 transaction to record (13.09 ،**9.69** ،**0.79** **1.04** ،**2.03**)% respectively. Carbohydrates in the A5 treatment increased to 73.36% but decreased in the A4 to record 52.50%. The weight and size had increased in the A5 treatment (370 g, 420) respectively, while the other qualities of the crust such as color, the nature of the crust, the consistency of baking, the symmetry of the body, the line of cutting and spreading were improved with the increase of the percentage of addition of almond flour to the A5 treatment to be (8**3** ،**3** ، **3** ،**3**) respectively. As for the qualities of the pulp in terms of graininess, pulp color, smell, taste, chewing, and texture were recorded (9**15** ،**10** ،**15** ،**10** ،**9** ،) respectively in transaction A5. Antioxidants and total phenols gave the highest content in treatment A5 to be 86.25%, while it decreased in treatment A1 to 56.69%, while total phenols recorded their highest increase in treatment A5 to 86.40 mg / 100 g, but it was low in treatment A to record 53.78 mg / 100 g. This study gives a good idea of improving the sensory and nutritional qualities of bread fortified with almond flour in various proportions and also provides antioxidants that can contribute to getting rid of free radicals in the body.

Keywords: Almond Bread, Almond Flour, Antioxidants, Sensory Evaluation, Total Phenols.

INTRODUCTION

Bread is an important food ingredient that is prepared from mixing flour of one or several types of cereals and is baked in the oven. The use of different models of bread has been developed depending on the culture of each country. the increased demand for healthy, natural, and functional products has contributed to several attempts to improve the nutrition and functional value of bread by modifying its composition by adding different types of flour, including almond flour, as almonds contain many nutrients, vitamins, and minerals. the use of almond flour is gluten-free [1]. The addition of almond flour to the processed biscuits reduced the moisture content, while the content of ash, total protein, total fat, and total dietary fiber increased. As for the total phenols, they increased significantly the higher the percentage of addition to oatmeal, which was 30% [2]. Almonds are widely used in the preparation of many traditional bakery and confectionery products, including almond cakes, and gluten-free bread, and it is also a substance rich in protein, amino acids, many bioactive phenolic compounds, antioxidants, flavonoids, hydrolyzable tannins, condensate and phenolic acids [3].

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Bakery products such as biscuits and bread are products with functional ingredients however, functional food production may entail quality defects in terms of possible changes in physical, chemical, and organoleptic features. In fact, functional components rich in fiber can interfere with the formation of gluten. These disadvantages will be minimal in the case of using concentrated biologically active extracts from almond by-products, but they can be even more pronounced in the case of the direct addition of blanching water and, above all, peeled husks to wheat flour [4]. Some researchers focused on the activation of traditional fermented semolina bread with almond peel, demonstrating that dried almond peel allows a constant release of phytochemicals from bread, the work showed a high ability to add almond peel to bread to provide antioxidant protection, health aspects, physical and chemical characterization, organoleptic measurements and the effect of shelf life on chemical content and health properties on the finished bread were evaluated to validate the reuse of almond byproducts at the bakery level [5]. The study aims to produce bread with a low gluten content to help diabetics and those suffering from intestinal disorders from eating a quantity of bread in addition it provides the best source of antioxidants that help get rid of free radicals.

Materials and methods:

The method used by Mustafa [6] the ingredients used were based on the weight of the flour, the flour was (100) g, yeast (1) g, sugar (0.5) g, salt (1) g, water according to the absorbency of the flour, almond flour was also used in the proportions of (525 ،20 ،15 ، 10 ،) %.

Method: the ingredients are weighed in advance, part of the water is added to make a sugary – saline solution and the other part to dissolve the yeast, noting the use of warm water (up to 32 m), the ingredients are added to the flour, including the raw materials that are under study (oatmeal, almond flour) and all mixed manually until full maturity of the dough, the dough is balled by hand and placed in a container intended for fermentation, this process is carried out at a temperature of 30-32 M and relative humidity not less than 85% the duration of primary fermentation lasts for 45 a minute.

This is followed by the process of gas ejection punching for seven seconds, after which the dough piece is returned to the fermenter as it enters the secondary fermentation stage (a rest period of 10 minutes), followed by the forming stage and here the same method is used as mentioned in AACC 10-10 [7]. After forming the final fermentation process is carried out for 60 Minutes under the same conditions, then the baking process is carried out at a temperature of 225 M, and for 25 minutes after the end of baking the bread is left to cool in the room atmosphere.

Measuring the volume of bread

The size of the laboratory bread was manually measured using the seed displacement method for millet.

Sensory evaluation of bread

The external and internal baking qualities were studied according to the laboratory bread evaluation system followed by the American Baking Institute.

Preparation of a solution of Gallic acid

Dissolve 0.5 g of gallic acid in 10 ml of ethyl alcohol and dilute with Ionic distilled water in a 100 ml volumetric vial and complete the volume to the mark to obtain a concentration of 5000 micrograms/ 100 ml from this first standard solution I took volumes by pipette (15 ،4 ،3، 2،) each of them was placed in a 1000 ml volumetric bottle and the volume was supplemented with iconic distilled water to the mark in order to obtain solutions with secondary standard concentrations of gallic acid, respectively: 50 micrograms/ L, 100 micrograms/ L, 150 micrograms/L, 200 micrograms / L, 250 micrograms / l [8]

The standard calibration curve was prepared by estimating the absorptivity of secondary standard solutions of gallic acid at a wavelength of 280 Nm and the absorption values of gallic acid were plotted against the secondary concentrations of acid. Figure (1) shows the standard calibration curve of gallic acid solutions in mg / mL versus absorption at a wavelength of 280 Nm and represents a straight line.

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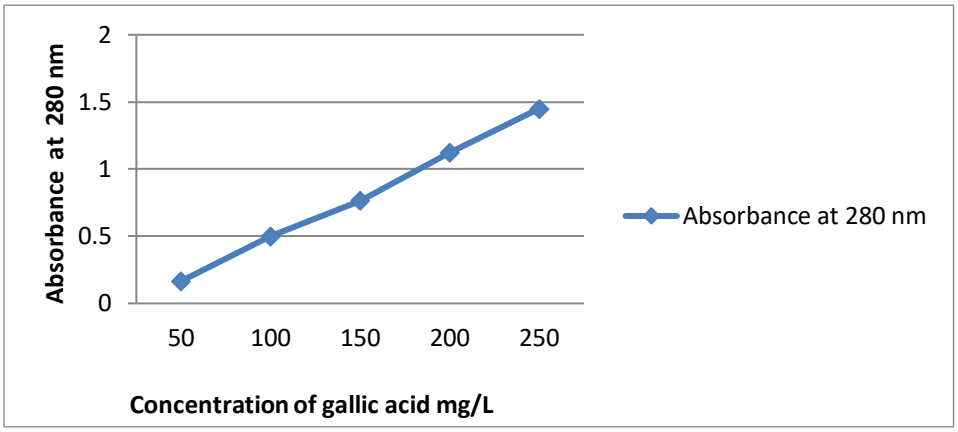

Figure (1) Gallic acid.

Fullin Detector

It was obtained ready-made from the manufacturer.

Preparation of a 2% Sodium Carbonate Solution

Dissolve 20 g of anhydrous sodium carbonate in 1 liter of Ionic water by heating on a hot surface, then cool the mixture to room temperature and filter after 24 hours and complete the volume to a liter with Ionic water.

Preparation of a solution of antioxidant potency

40 mg of DPPH substance (2,2-diphenyl-1-picrylhydrazyl) was dissolved in 100 ml methanol and stored at room temperature, 0.5 ml of bread was taken and 1 ml of DPPH solution was added to it and kept in a dark place for two hours, then the absorbency was measured at a wavelength of 517 Nm, the calculation was made by comparison with the control sample Blank which is 0.5 ml methanol + 1 ml of DPPH solution and the percentage was estimated using the following equation :[9]

$$\text{DPPH \%} = \frac{\text{A Blank} - \text{A Sample}}{\text{A Blank}} \times 100$$

Chemical tests performed on bread:

Humidity estimation :

The humidity percentage was estimated according to the mentioned method [10] by the Rapid moisture test device at a temperature of 105 m until the weight was fixed.

Fat estimation:

The fat content was estimated according to the method mentioned in [10] using the soxhelet soxhelet extraction device using petroleum ether.

Protein estimation :

The protein percentage was estimated by the microkaldal method according to what was mentioned in [10] and then the resulting amount of nitrogen was multiplied by the coefficient 6.38 to extract the protein percentage.

Ashes estimation:

I followed the standard method mentioned in [10] at a temperature of 550 m and left the samples until obtaining a whitish-gray color.

Carbohydrate estimation :

The difference between the components (moisture, fat, protein, ash) subtracted from the 100 mentioned in [10] is calculated mathematically by the method as follows :

Total carbohydrates % = 100 – (moisture % + ash % + fat % + protein).

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The analysis of the chemical composition of bread produced from wheat flour and partially replaced with almond flour, as we find noticeable changes in the main components of bread, the results are shown in Table 1, giving the highest percentage of moisture in the treatment to which almond flour was added 5% almonds, recorded 29.83%, while the lowest percentage was 13.09% for the treatment to which 25% almonds were added. This change can be explained by the fact that almonds have a high-fat content that may help increase the absorption of water in the dough, increasing the moisture content. Increased humidity makes the dough softer and easier to knead, which improves the final baking properties. He explained [11]. The moisture in the wheat flour reaches 11.1%, the moisture in the almond flour is 4.32%, and the resulting moisture in the bread is the result of the flour retaining a percentage of moisture so that the resulting bread has good specifications.

As for the percentage of fat, the results showed significant differences at a significant level of 0.05 < p, as the percentage of fat increased to a record 1.53% for the treatment with the addition of 20% almonds, while the lowest percentage was 0.79% when adding 25% almonds. Almonds contain natural fats such as unsaturated fatty acids, which improve the texture and flavor of bread. However, caution should be taken against increasing the percentage of fat to avoid unwanted fatty taste and reduce the shelf life of bread due to the increased likelihood of oxidation. These results do not agree with [12], as the percentage of fat in the biscuits added with almond flour in different proportions ranging from (31-43)%, as stated [13] that almond flour contains a fat content of up to 25.83%.

At the same table, the protein percentage was significantly different to give, the highest protein percentage was 12.78% when adding 20% almonds, and the lowest percentage was 9.69% when adding 25% almonds. The high protein content is due to the high content of vegetable proteins in almonds, which enhances the nutritional value of bread and strengthens the structure of the dough. [12] the percentage of protein in the biscuits produced ranges from (18-22)% depending on the percentage of almond flour added to the product. He explained [14] that different varieties of almond flour have a protein content of 2.75-4.69%. Also, buckwheat flour has a good protein content.

The results of the ash percentage have registered a slight increase, as the percentages ranged between (2.03-2.90)%. Almonds contain a variety of minerals such as potassium, calcium, iron, and zinc, which increase the nutritional value of bread. These results are consistent with [7], which showed that almond flour has an ash content of up to 2.9%

The highest percentage of fiber was 1.89% when adding 20% almonds, and the lowest percentage was 1.04% when adding 25% almonds. The dietary fiber contained in almonds contributes to better digestion and increases the nutritional value of bread. These results do not agree with [15], as it was found that the percentage of fiber in almond flour is 7.92%.

The percentage of carbohydrates differed significantly in the same table to record the highest percentage when adding 25% almonds, which was 73.36%, while the lowest percentage was 52.50% when adding 20% almonds. This change can be caused by the fact that almonds contain less carbohydrates than buckwheat, which causes the percentage of carbohydrates in the dough to decrease when almonds are added.

Table (1) The effect of almonds on the chemical properties of bread.

Transactions	Carbohydrates (%)	Fiber (%)	Ash (%)	Protein (%)	Fat (%)	Moisture (%)
A	58.31 ± 0.001	1.32 ± 0.001	2.19 ± 0.001	11.43 ± 0.001	1.12 ± 0.001	25.63 ± 0.001
A1	53.34 ± 0.001	1.43 ± 0.001	2.32 ± 0.001	11.89 ± 0.001	1.19 ± 0.001	29.83 ± 0.001
A2	56.73 ± 0.001	1.54 ± 0.001	2.55 ± 0.001	12.21 ± 0.001	1.32 ± 0.001	25.65 ± 0.001
A3	54.10 ± 0.001	1.72 ± 0.001	2.74 ± 0.001	12.46 ± 0.001	1.32 ± 0.001	27.66 ± 0.001
A4	52.50 ± 0.001	1.89 ±	2.90 ±	12.78 ±	1.53 ±	28.40 ±

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		0.001	0.001	0.001	0.001	0.001
A5	73.36 ± 0.001	1.04 ± 0.001	2.03 ± 0.001	9.69 ± 0.001	0.79 ± 0.001	13.09 ± 0.001

A: Bread from wheat flour 100%, A1: wheat flour 95% + almond flour 5%, A2: wheat flour 90% + almond flour 10%, A3: wheat flour 85% + almond flour 15%, A4: wheat flour 80% + almond flour 20%, A5: wheat flour 75% + almond flour 25%.

Sensory evaluation of bread with added almonds:

The results of the sensory evaluation are shown in Table (2), as the weight of the samples gradually increased with an increase in the percentage of addition to 370 g in the treatment with an addition of 25%, while it decreased in the standard treatment to 300 g. As for the size of the bread, it gradually increases from 335 cm3 in the standard sample to 420 cm3 when adding 25% of almond flour, which indicates that almonds enhance the size of the bread and make it look bigger and fuller. The qualitative volume shows a slight increase in samples with a higher almond content, which suggests that almonds can contribute to an improved distribution of gases in the dough.

As for the color and nature of the shell, the color remains constant at 2, which means that almonds do not noticeably affect the color of the shell. The nature of the crust also remains constant at 2, which indicates that almonds do not significantly change the properties of the outer crust of bread. The consistency of baking and the symmetry of the body remain constant at 2 in all samples, which indicates that the addition of almonds does not adversely affect the overall distribution of ingredients or The Shape of the finished baking.

With regard to internal properties, the graininess improves with an increase in the proportion of almonds, reaching 10 in a sample of 25% almonds, which suggests that almonds may help improve the texture of the pulp and make it softer. The color of the pulp remains constant at 8-9, which means that almonds do not significantly affect the color of the pulp.

The aroma shows a slight improvement in samples with higher almond content, reaching 9 in a sample of 25% almonds, indicating that almonds add a pleasant aroma to baking. The Taste shows a slight improvement with an increase in the proportion of almonds, reaching 15 in a sample of 25% almonds, indicating that almonds add a grainy flavor to baking.

Chewing shows a slight improvement with an increase in the proportion of almonds, reaching 15 in a sample of 25% almonds, indicating that almonds can improve the texture of bread and make it softer and easier to chew. The consistency remains constant at 12-15, which means that almonds do not significantly affect the overall consistency of baking.

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الصفات الداخلية							الصفات الخارجية											
100	15	10	15	10	10	10	3	3	3	3	8	10						
صفات اللب							صفات القشرة					الحجم						
المجموع	القوام	المضغ	الطعم	الرائحة	لون اللب	صفة التحبب	خط القطع والانتشار	تماثل الهيئة	تناسق الخبيز	طبيعة القشرة	اللون	الحجم النوعي	علامته	الحجم	الوزن	مستوى الإضافة	رقم المعاملة	ت
	12	8	12	7	7	8	2	2	2	2	6		7	335	300	%100 طحين حنطة	control	1
	13	8	13	8	8	9	2	2	2	2	7		8	345	310	%5 طحين لوز	B1	2
	13	8	13	8	8	8	2	2	2	2	7		8	360	320	%10 طحين لوز	B2	3
	14	9	13	8	8	8	2	2	2	2	7		8	375	330	%15 طحين لوز	B3	4
	14	9	14	9	9	8	2	2	2	2	8		8	390	350	%20 طحين لوز	B4	5
	15	10	15	10	9	9	3	3	3	3	8		9	420	370	%25 طحين لوز	B5	6

Table (2) Sensory evaluation of bread with added almonds.

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