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RESEARCH ARTICLE

PRODUCİNG A CUPCAKE FROM ALMOND FLOUR AND STUDYİNG İTS SENSORY AND NUTRİTİONAL QUALİTİES TO SERVE İT TO CHİLDREN WİTH AUTİSM

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ABSTRACT

The study was conducted to search in the laboratories of the College of Agriculture, Tikrit University, as the raw materials were provided from the local markets, and pieces of carrots were added in varying proportions (5, 10, 15, 20)%, and the coefficients were named (L4, L3, L2, L1). In relation to the addition in carrot pieces, while L was considered the standard treatment to which carrot pieces were not added, and a chemical analysis, sensory evaluation, and evaluation of antioxidants and total phenols were conducted on the studied samples in different treatments and the mineral elements in them, it was noted that a rise in moisture content Fat, protein, ash and fiber in treatment L4, in which the percentage of addition was 20% of the carrot pieces used, which amounted to (4.55, 8.09, 3.67, 2.29, 2.32)%, respectively, while the chemical estimates of moisture content, fat, protein, ash and fiber decreased in the standard treatment compared to In other treatments to reach (4.03, 7.09, 2.77, 1.13, 0.56)%, respectively, while carbohydrates had increased in the standard treatment only to record (83.42)%, but the lowest percentage of carbohydrates was in treatment L4, which recorded (79.08%). When conducting the sensory evaluation, the characteristics differed significantly, as the characteristics of color, smell and texture had increased in treatment L2 to be (19, 19, 29) respectively, while the taste had increased in treatments L2 and L4 to be 29 for each. An estimate was made for the total antioxidants and phenols, as the study showed a rise in them with the increase in the percentage of addition of carrot pieces in the treatments. The highest percentage of antioxidants estimated by the DPPH reagent was 27.78% for the L4 treatment. The highest percentage of total phenols was recorded in the treatment L4, which amounted to 60.61 mg / 100 gm, but the lowest content of them was in the standard treatment L, which recorded 55.53 mg / 100 gm. The estimation of mineral elements showed a rise in their proportions with an increase in the percentage of addition of carrot pieces in the studied treatments.

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INTRODUCTION

With the development of economic regions, globalization and urbanization, the health of the majority of people worldwide has deteriorated with the increase in the burden of non-communicable diseases, namely obesity, cancer, diabetes, stroke, coronary heart disease, hypertension, etc (Goyal, 2015). Due to modernization and increased nutritional awareness, the population has become more interested in using health-beneficial factors in specific functional foods. With the emergence of the concept of functional foods, the development of foods with various health benefits has become prominent (Amal, 2015). Celiac disease is a condition of chronic inflammatory bowel secondary to gluten sensitivity (AOAC, 2019) Lifelong elimination of gluten from the diet is the only treatment available recently. This exclusion can be achieved by completely restricting wheat, barley, rye, triticale, and various sources of gluten. Partial replacement of wheat flour with other alternatives from a good source for formulating gluten-free bakery products for celiac, diabetic, and autistic patients is one of the alternatives currently being used in many countries (Baljeet Singh Yadav, 2014).

Many studies have appeared at the present time to evaluate the effect of replacing wheat flour with a gluten-free flour such as almond flour and to study the rheological and sensory properties of cakes or pastries made from almond flour. As wheat flour was replaced with almond flour in different proportions with a concentration of 20, 30 and 40%, the results showed a good content (23%) of crude protein and fiber (4.89%) in flour compared to flour, color analysis showed that the increase in color sharpness with 40% Almond flour and 20% almond flour retained their natural yellow colour. Acceptance analysis showed a high score of 90.7 and 87.5 for almond and chickpea flour alternatives, respectively (Wrigley, 2006). The cupcake produced from almond and coconut flour, which is gluten-free and contains varying amounts of almond flour and coconut, was evaluated in terms of textural and sensory characteristics, as it was noted that almond flour gave the best evaluation than coconut flour in terms of size, crumbs, taste and texture. Almond flour, which is obtained by grinding almonds, is one of the healthy alternatives to wheat flour. Almond flour can be used to prepare bread and other types of pastries, cakes, and biscuits. Almond flour contains many vitamins and nutrients, and it is characterized by not containing gluten.

Therefore, it is suitable for patients who suffer from health problems as a result of their intake of gluten (Chen Hong, 2022). The calories in almond flour are relatively few, as 28 grams of almond flour provide the body with 163 calories. However, it is about 50% higher than the calories found in wheat flour. Although almond flour contains fewer carbohydrates, it is rich in fat (Entisar, 2022). Scientific studies indicate that most autistic children tend to stay away from healthy foods such as vegetables and fruits, and prefer light and processed foods. This thing will affect their digestive system, their stomach, and even their behavior. From here comes the importance of having a diet for autistic patients (Naqash, 2017) (Ezeama, 2009). The preparation of the plan is to train children with autism to eat healthy and useful foods that help improve their behavior and health. This is done by changing their behaviors towards certain foods. So that parents are trained on a specific behavioral approach so that they can change the outlook of their children and persuade them to eat useful foods, as caring for autistic patients needs great knowledge and know-how. Hence, gluten-free foods were added and contributed to raising nutrients in children (Wieser, 2007).

The aim of the study is: Producing functional foods that can be used by children, which can raise the nutritional value of these products. It is also possible to provide food, including cupcakes made from almond flour, which has become popular recently, and which is a gluten-free food. The use of almond flour alone or with a mixture of other types of flour is considered an alternative to wheat flour that contains gluten, which is not allowed in foods for autistic children.

MATERIALS AND METHODS

How to prepare the cupcake: Almond flour was purchased from local markets along with pieces of carrots available in local markets. Table 1 shows the materials and proportions of ingredients in the cupcakes and according to the method used by (Amal &Hoda, 2015) in preparing the cupcakes with some modifications in the mixture, as eggs were used in To help the cupcake stick together and increase its nutritional value, honey and corn oil were mixed together, then the other dry ingredients were added to the mixture and mixed manually for two minutes, then warm water and vinegar were added and mixed well. Carrot pieces were added to the mixture in different proportions (5, (10, 20,15) % and mix well until the pieces are distributed. The standard treatment was considered to be the one that does not contain carrot pieces. The mixture is poured into small cupcake trays greased with butter, and baked at 177 degrees Celsius for 15 minutes, after which it is left to cool and then packed in Polyethylene bags until the required analyzes are performed.

Chemical tests performed on the cupcake

Moisture rating: Moisture.

Moisture percentage was estimated according to the aforementioned method (2019, A.O.A.C) using a Rapid moisture test device at a temperature of 105 °C until the weight is proven.

Fat rating: Fat.

The percentage of fat was estimated according to the method mentioned in (2019, A.O.A.C) using the Soxhelet extraction device using petroleum ether.

Protein Estimation: Protein

The percentage of protein was estimated by the micro calcification method according to what was mentioned in (2019, A.O.A.C), then the amount of nitrogen produced was multiplied by a coefficient of 6.38 to extract the protein percentage.

Ash rating: Ash

The standard method mentioned in (2019, A.O.A.C) was followed at a temperature of 550 °C and the samples were left until
Get a whitish gray color.

Carbohydrate Estimation: Carbohydrates

It was estimated mathematically using the method of the difference between the components (moisture, fat, protein and ash) subtracted from the 100 mentioned in (2019, A.O.A.C) as follows:

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

Cupcake Sensory Evaluation:

A sensory evaluation of cupcakes was conducted by 15 evaluators from the Department of Food Sciences - College of Agriculture - University of Tikrit

The evaluation was according to Table 2 listed and the values established on it and followed by (Entisar & Marwa, 2022).

Estimation of the antioxidant activity: The antioxidant activity of fruit mug cake was estimated by adopting the method of estimating the effect of inhibiting free radicals, as 2 g of cake was used, then the antioxidant activity was estimated according to the method described by (Al-Nasseri, 2021), as (0.004 mg) of DPPH was dissolved in 100 ml of methanol with a concentration of 95% was taken. 1 gm of cupcake samples were taken and 5 ml of methanol was added to it and left for 24 hours. After that, a centrifugation of the samples was performed and the filtrate was taken to be evaluated. After that, 0.5 ml of each concentration of the samples was taken and added to it. 3 ml of DPPH solution. The samples were incubated for half an hour in the dark at room temperature, then the absorbance was read at a wavelength of 517 nm against the control absorbance, which was prepared by taking 3 ml of DPPH solution and adding 0.5 ml of methanol solvent to it, and the inhibitory effect of the root was calculated.

According to the following equation:

$$\text{Free radical inhibitory effect} = \frac{\text{Absorbency control - the absorbance of the mixture}}{\text{Absorbency control}} \times 100$$

Determination of total phenols in Cupcake: 5 gm of cake was taken and placed in test tubes and 0.5 ml of 10% diluted Follen's reagent was added to it, the mixture was mixed and left for 6 minutes, then 1 ml of 7.5% sodium carbonate solution was added to it and mixed, and the mixture was left in a dark place at room temperature for two hours. Then the absorbance was read at a wavelength of 765 nm using a spectrophotometer, and the percentage of total phenols was calculated through the standard curve of gallic acid.

Estimation of minerals: The mineral elements were estimated in milk samples, which included (sodium, potassium, magnesium, iron, calcium, copper, zinc) according to the method approved by (2019 A.O.A.C), by incinerating 3 g of samples at a temperature of 350 °C until white ash is obtained, then melting The resulting ash was dipped in 5 ml of 5% nitric acid and mixed well, then the mixture was filtered and 1 ml of the filtrate was taken and the volume was filled with distilled water to 10 ml. The mineral elements were estimated using an atomic absorption spectrometer.

(Atomic absorption spectrophotometer)

Statistical analysis: The results were analyzed statistically using the (SAS, 2001) program, according to one-way analysis of variance, and the arithmetic means of the coefficients were tested using Dunkin's multiple test, with a significant level of 0.05 to determine the significant differences between the groups (Mahaffey & Duncan, 1994).

RESULTS AND DISCUSSION

A chemical analysis of the produced cupcake samples was conducted to find out the effect of the product with additions from carrots, in addition to the flour used being almond flour, which is considered gluten-free. Components The results showed that the moisture content increased relatively with the increase in the addition of carrots, which was the highest significant mean in the L4 treatment, reaching 4.55%, while the least significant was for the standard treatment, which amounted to 4.03%. A good percentage of fiber, which contributes to the absorption of an additional amount of water. The moisture content is very important in terms of storage for bread and pastries, which affects their storage ability and preservation (Ezeama, (2009). Water plays an important role in bread and pastries as it is a medium for dissolving sugars, bread grains, and others, as well. That the optimal texture of these products cannot be obtained except with the presence of liquid materials, including water, which is a medium for the distribution and dispersion of various components such as proteins and sugars, and obtaining the ideal properties of the product (Stradiety, 2004). Upon noticing the percentage of fat, it had increased in the L4 treatment compared to the rest of the treatments, to record 8.09%, while it decreased to record the lowest level in the standard treatment of 7.09%. Also, the molds used were greased with butter, which may have been associated with the outer crust of the cupcake, and thus these differences appeared. The protein results showed a significant difference for the treatments among them, as the percentage of protein increased in treatment L4, which recorded 3.67%, but in the standard treatment, the averages were the lowest, as it recorded 2.77%. Protein reaches 1 gm / 100 gm, although the percentage is low, but increasing the percentage of addition to the product increases the possibility of raising the percentage of protein. It was observed that the percentage of ash increased with the increase in the percentage of addition, as it reached 2.29% for the L4 treatment, which is the highest percentage of addition to carrots, which was 20%, while the standard treatment had the lowest percentage of ash, reaching 1.13%. In addition to carrots, which contain mineral elements such as calcium, potassium, and other necessary mineral elements (Nagraj et al., 2020), in addition to that almond flour and eggs contain a percentage of mineral elements that appear in the chemical composition.

Dietary fiber - found mainly in fruits, vegetables, whole grains and legumes - is known for its ability to prevent and relieve constipation. But high-fiber foods may provide other health benefits as well, such as helping to maintain a healthy body weight and lowering your risk of diabetes, heart disease or some types of cancer. Due to the importance of fiber, the results showed a gradual increase in its percentage in the studied treatments, with an increase in the percentage of carrots added to the mixture, as it reached the highest percentage of 2.32%, which was in treatment L4, while the standard treatment gave the lowest percentage of fiber, which amounted to 0.56%. Almond flour contains a slight percentage Of the fibers, which appeared in the standard treatment, the lowest percentage among the treatments. Carrots contain a percentage of fiber up to 2.2 gm / 100 gm (Al-Gharab et al., 2014). The results of carbohydrates through the difference between the components showed that the highest percentage was in the standard treatment, which recorded 83.42%, while the lowest percentage was in the L4 treatment, which amounted to 79.08%. Through the sensory evaluation of the characteristics of the cupcakes studied in the research, it was observed that there were significant differences in the characteristics studied at a significant level of $p < 0.05$ for all the studied characteristics, as treatment L2 gave the color characteristic the highest evaluation among the treatments, which was 19, but the lowest value was for the two standard treatments and L3 As they recorded 17, the residents noticed that the color of the outer crust had deteriorated in both treatments. The reason for the color deterioration in the standard treatment is attributed to the fact that almond flour is not like wheat flour in its associations, as it could be that the period of its stay in the oven affected it, or that the mildew reactions that occurred were not Feasible in giving the required color, and the L3 treatment had given a lower evaluation because of the color of its skin, which the evaluators did not want. As for the smell characteristic, the L2 treatment was superior to give 19, which is the highest evaluation among the treatments, but the standard treatment gave the lowest evaluation, which amounted to 16. Giving the standard treatment the lowest evaluation, this does not mean that the smell was not good, but the different additions to carrots helped give a distinctive smell to the product Which contributed to showing significant differences in the transactions. When tasting the taste of cupcakes, the two treatments L2 and L4 showed superiority as they scored 29 compared to other treatments, while the evaluation of the taste deteriorated in treatment L3 to score 16, which is the lowest evaluation among the treatments. The characteristic of stature was the best in treatment L2, as the evaluation scored 29, but the lowest evaluation was for treatment L4, as it reached 26. The reason for the deterioration of the consistency is due to the inability of the almond flour to hold the ingredients together, such as wheat flour, which contains the glutenous network, which gives a good and cohesive texture.

Antioxidants are substances that fight free radicals in the body, and prevent or slow down cell damage caused by free radicals and unstable molecules in the body. Antioxidants play a role in fighting the signs of aging, and they also have an important role in boosting the body's immunity. The most important and prominent role of antioxidants is to get rid of free radicals and avoid their damage to different cells in the body. The total antioxidants were estimated through the use of DPPH as a reagent. Figure 1 shows the differences in the percentage of antioxidants with the increase in the percentage of added carrot cuttings, as the highest percentage was for L4 treatment, which recorded 27.78%, as the percentage of carrot cuttings was the highest percentage used in the research. Carrots contain natural antioxidants that contribute to raising their percentage with the increase in the addition of treatments, while the lowest percentage was for the standard treatment, which recorded 20.09%. (Carlos, 2014) stated that carrots are a gold mine of antioxidants. The carotenoids, polyphenols, and vitamins in carrots act as antioxidants, anticancers, and immunomodulators. The widely distributed carotenoids in orange carrots are powerful antioxidants that can neutralize the effect of free radicals. It has been shown that antioxidants have inhibitory mutations that contribute to reducing the risk of some types of cancer. Carrots are rich in the polyacetylene antioxidant, falcarinol, which fights cancers by destroying pre-cancerous cells in tumors. In this way, carrots have anti-cancer properties that prevent the growth of cancer cells in the colon and support a healthy digestive system. Carrots contain a variety of nutrients and antioxidants combined Vitamin C (Mangla et al., 2021). Almond flour also has an important role in antioxidants, as it is rich in antioxidants, especially vitamin E, which is considered one of the important natural antioxidants for the body.

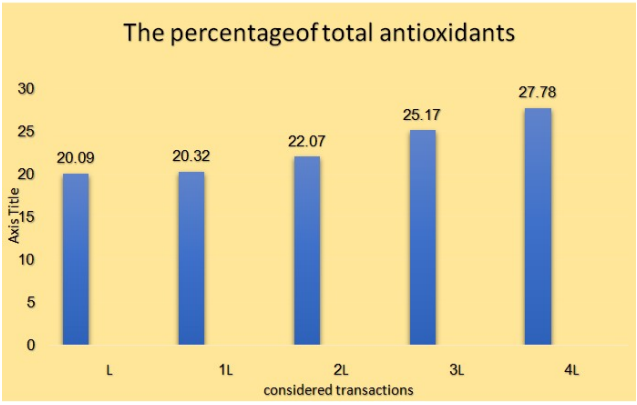

Figure 1. Percentage of the free radical inhibitor DPPH

Most of the organisms of the plant kingdom contain natural phenols within their cells and various tissues, where they are concentrated in leaves, flowers, fruits and roots. They are foodstuffs with antioxidant properties that play many roles in protecting the body from various chronic diseases, infections, tumors, and others.

Table 1 Ingredients and proportions for cupcake mix

the components	L	L1	L2	L3	L4	Type, country of origin
almond flour	200 gm	200 gm	200 gm	200 gm	200 gm	
Corn oil	42 gm	42 gm	42 gm	42 gm	42 gm	Afia - Saudi Arabia
honey	120 gm	120 gm	120 gm	120 gm	120 gm	From the apiaries of Salah al-Din Governorate
salt	3 gm	3 gm	3 gm	3 gm	3 gm	Family - Iraq
Baking powder	2 gm	2 gm	2 gm	2 gm	2 gm	Family - Iraq
Sodium bicarbonate	1 gm	1 gm	1 gm	1 gm	1 gm	Iraq
Vinegar	40 ml	40 ml	40 ml	40 ml	40 ml	White - Iraq
eggs	1	1	1	1	1	Iraq
water	100 ml	100 ml	100 ml	100 ml	100 ml	Tap water
vanilla	2 gm	2 gm	2 gm	2 gm	2 gm	Family - Iraq
carrot	-	5 gm	10 gm	15 gm	20 gm	Iraq

Table 2 Sensory evaluation of the produced cupcake

transactions	the color 20	Odor 20	Taste 30	Texture 30

Table 3. Chemical analysis of the produced cupcake

transactions	Humidity%	Fat%	Protein%	Ash%	Fibers%	Carbohydrates%
L	4.03 d	7.09 d	2.77 a	1.13 e	0.56 e	a83.42
L1	4.45 c	7.72 c	2.89 d	1.62 d	1.79 d	b 81.53
L2	4.49 b	7.77 c	3.21 c	1.79 c	1.90 c	c 80.84
L3	4.51 ab	7.98 b	3.43 b	2.09 b	2.07 b	d 79.92
L4	4.55 a	8.09 a	3.67 a	2.29 a	2.32 a	e 79.08

Table 4. Sensory evaluation of the produced cupcake

transactions	Color20	Odor20	Taste 20	Texture 20
L	17 c	16d	27 c	27 c
L1	18 b	17 c	28b	28 b
L2	19 a	19a	29a	29 a
L3	17c	17c	26d	27c
L4	18b	18 b	29 a	26 d

The total phenols were estimated in the studied treatments through a foline reagent, and it was noticed through Figure 2 a difference in the amount of total phenols present in the treatments, as a rise in their quantity was observed with the increase in the addition of carrot pieces to the studied cupcake treatments, so the highest value was in the L4 treatment, as it amounted to 60.61 mg / 100 gm, while the lowest content was in the standard treatment, which amounted to55.53 mg / 100 gm. (Mangla et al., 2021) showed that carrots contain multiple phenols of up to 70.60 mg / 100 g, and the percentages of phenols vary according to the soil, the use of pesticides, and other factors that contribute to raising or lowering these percentages.

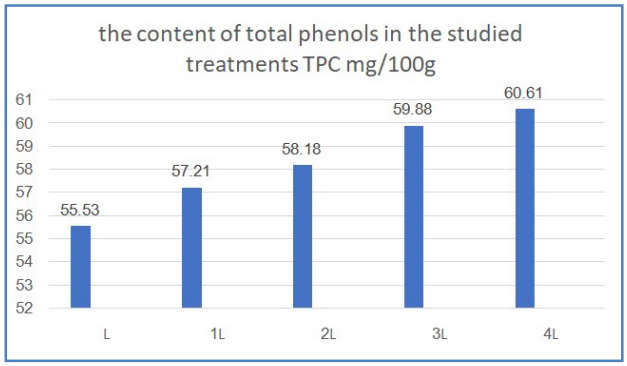

Figure 2. Total phenols in TPC transactions studied

(Chen et al., 2022) showed that the storage period of carrots affects the phenolic content, and the longer the storage period, the more phenols the product loses. Phosphorus and calcium are mainly involved in the formation and construction of bones and teeth, and they strengthen and give them immunity and resistance, while zinc is involved in the synthesis and construction of enzymes, and the same applies to iron, as it is involved in the formation of hemoglobin. Mineral elements work to balance the acid-base in the body, that is, they maintain it so that it remains within its normal rate in the blood, i.e. about 7.35, and among the most important elements that achieve the acid-base balance in the human body are the elements magnesium, potassium, sodium, sulfur, phosphorus and chlorine. Maintaining osmotic pressure, as some of these elements work to achieve the balance of water in the body, as it maintains the balance of water in different cells, and the elements sodium, potassium and chlorine play an important role in achieving this balance. Transmission of nerve impulses The exchange of sodium and potassium through the cell membranes associated with nerves transmits nerve impulses from one nerve cell to another due to the change in the amount of electrical charge present in the cell membrane. Muscle contraction and relaxation The balance between the elements that stimulate muscle contraction, such as calcium, and the elements that stimulate muscle relaxation, such as sodium, potassium, and magnesium, in order for the muscles to perform their role and the tasks assigned to them to the fullest. Activation of biochemical reactions that interfere with the products of reactions that occur in the body, and they act as cofactors

such as zinc, which activates no less than 100 enzymes, and the same applies to iron, copper, selenium, potassium and magnesium, as each of these elements activates varying numbers of reactions. The most important major mineral elements Calcium: It is one of the mineral salts necessary for the human body, as it is available at a rate of 2 percent of the total body weight. Phosphorus: Phosphorus is closely related to calcium and potassium: Potassium is one of the positively charged ions that are found in the cells of the body. The results showed differences in mineral elements among the studied treatments, as the percentage of sodium ranged between (32.02-33.59) mg / 100 g. The percentage of potassium also increased with the increase in the percentage of carrot addition, as the highest percentage was 36.85 mg / 100 g in the L4 treatment, while the lowest percentage was in the standard treatment, which was 28.77 mg / 100 g. The percentage of magnesium ranged between (12.63-12.63). (14.03) mg / 100 gm, while the percentage of iron began to rise with the increase in the percentage of adding carrots significantly to reach 3.15 mg / 100 gm, but the standard treatment was the lowest percentage to record 2.22 mg / 100 gm. From the observation of calcium, its percentage increased in the treatments to reach 77.06 mg / 100 g, which is the highest percentage recorded among the studied treatments, and the lowest percentage was 40.44 mg / 100 g. As for the percentage of copper in the studied treatments, it ranged between (2.88-3.79) mg / 100 gm. The percentage of zinc ranged between (1.22-1.66) mg / 100 gm. Almonds and carrots are rich sources of major and minor mineral elements, which are important for the proper functioning of the body. Almonds are rich in potassium, iron, phosphorous, calcium and sodium. Carrots are rich in copper, manganese, calcium, iron, phosphorous, potassium and magnesium. This explains the high percentages of mineral elements in the treatments, although the percentages of addition were not very large. And that these quantities contribute to filling the daily need of mineral elements for children aged 4-8 years, as in addition to the diet followed for them, the cupcake product will contribute to gradually addressing their deficiency of micro and macro nutrients. The daily requirements of mineral elements can be distributed evenly in the child's diet so that the food is more beneficial.

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