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Research Article/Araştırma Makalesi

The influence of tomato seed flour on the nutritional value and quality of bread

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Abstract
The purpose of this research was to enhance the bread's quality by adding tomato seed flour to it. At the levels of 2, 4, and 7%, tomato seed flour was substituted by wheat flour for producing bread. bread quality was evaluated and contrasted with that of bread without tomato seed using its physical, color, crumb cell, textural, and sensory qualities physicochemical characteristics, amino acid and minerals content were determined .The analysis revealed that the tomato seed flour had moisture 11.33%, protein 31.66%, crude fat 20% , total ash 3.16 % and carboyhdrates 35.5%, The sample has a lot of magnesium content 29mg/g, sodium 15.7mg/g , potassium 7.06 mg/g, and calcium 0.76mg/g are the highest content 75.77 mg/g ,Iron 72.28 mg/g , Zin 57.645 mg/g and Cu 14,205 mg/g . According to the findings, the seeds revealed a high protein content 31.66% rich in Lucien and lysine. Finally, the tomato seed can be regarded as a good source of minerals and protein in nature.

1. Introduction

One of the most popular vegetables consumed worldwide is the tomato (Lycopersicum esculentum), which can be eaten either fresh or prepared. In fact, tomatoes are only second to potatoes in popularity in Europe and the US. They are of significant economic value and are utilized in the food industry as a raw material to make a variety of goods, including juices, sauces, purees, pastes, and canned tomatoes. Tomato eating has been linked in recent years to the prevention of a number of ailments. (González *et al*.,2011).

The issues with industrial waste are getting more difficult to overcome, and a lot of work will be required to maximize the nutritional and industrial potential of waste and byproducts and untapped markets for agricultural goods. Tomato industrial processing produces by-products, such as tomato seeds, peels, pulp, and cores, which account for 10–30% of all processed tomatoes(Isik and Yapar,2017).About 3-7% of the tomatoes that are processed produce byproducts which is a. significant quantity weight that causes significant environmental issues for the impacted business because of the the organic material's disposal(Del Valle *et al.*,2007; Zuorro *et al*.,2011).

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About 20 to 50 g.kg-1 of the tomato pomace's by-products are tomato peel and seed. tomatoes' original weight which can be used singly or in combination(Knoblich *et al.*,2005)

Tomato seeds were found to contain significant concentrations of essential amino acids, indicating that they contain high-quality proteins with a high lysine content (3.4-5.9%).A little more than 13% more lysine can be found in tomato seeds than in soy protein(Mironeasa and Codina ,2019). Consequently, the tomato Various low-lysine food products that are lacking in this amino acid may benefit from seed fortification. One of these products is bakery goods which use wheat flour as a basis ingredient because it contains less lysine. Tomato seeds are a better source of proteins than other unconventional sources since they don't contain any anti-nutritional elements, in contrast to other seed sources (Rahma *et al*.,1986) given that tomato seed protein has a high lysine concentration, it may significantly enhance the protein quality of low lysine cereal products are available ((Isik and Yapar ,2017)

2. Materials and Methods

This study's ingredients, which included commercial wheat flour, tomato, dry yeast, sugar, and salt, were all bought from market in Basrah.

2.1. Preparation of tomato seed flour

Tomato seeds cleaned and dried at 40 °C in an oven for 24 h from 5.0% to 0.2% moisture content. dried tomato seeds were pulverized (Electrical coffee mill, HE.HOUSE China). to make whole flour, dried tomato seeds were crushed. The chemical properties of tomato seed flour were determinated (moisture, protein, Fat, Ash, using AOAC method (1984). The total carbohydrate was determined using differentiation.

2.2. Functional Properties

Oil and water absorption capacity were calculated using the method given by Osobie e*t al.*(2013)for calculating oil and water absorption capacity. weighed and dispensed into a test was 1g of sample with 10ml of distilled water and refined vegetable oil were added to the test tube. after being fully mixed, the sample was let to stand for 30 min at room temperature .A mixture was centrifuged for 30 minutes at 1,500 rpm. The supernatant's free water or oil content was transferred and calculated. The capacity to absorb water and oil was calculated as follows:

WAC = (Vw1-Vw2)/quantity of the utilized sample

OAC = (Vo1-Vo2)/sample quantity utilized

Where: WAC = Water absorption capacity; Vw1 = Initial water volume; Vw2 = Final water volume; OAC = Oil absorption capacity; Vo1 = Initial Oil Volume; Vo2 = Final Decanted

2.3. Swelling index

A test tube was filled with 1g of the sample, leveled and the height was recorded. after adding 10 ml of distilled water to the sample, the test tube was permitted to stand for an hour. It was calculated as the ratio of the sample's unit weight's height to the sample .sample that was swelled was exposed to too much water for one

hour (Osobie *et al*., 2013**)** The sample's height was then measured and the swelling capacity was determined as follows:

Swelling capacity= V2 / V1

Where: V1 = Initial height occupied by sample.

V2= Height occupied by sample after swelling

2.4. Amino acid determination

The examination was conducted in the laboratories of the Ministry of Science and Technology / Department of the Environment, using a Korean-origin amino acid device. The method presented by the scientist Scriver CR, 2001 was used, where the carrier phase consisting of methanol: acetonitrile: 5% phosmic acid (ZORBAX Eclipse-AAA:3.5mm:Lxi.d=150x4.6mm) was used to separate the amino acids, while a fluorescence detector was used to detect Amino acids at wavelengths (Ex=445nm, Em=465nm). Use Clarity 2015 program to analyze amino acids.

2.5. Minerals determination

One gram of tomato seed powder is weighed and placed in 25 ml test tubes, the top of which is covered with a glass stopper. To each sample3 ml of nitric acid and 1 ml of $HClO_4$ are added, then the tubes are shaken, covered with a glass stopperand left for 24 hours under a vacuum.t he tubes are placed in a water bath 30 minutes to accelerate digestion. added to the tubes after removing them from the water bath 2-3.D.W.(strandard method, 2005).

The method of digestion K, P and N for powder seeds tomato. weight 200 mg of powder and put in baker 100 ml. added 5 ml H_2SO_4center. add 2-3 acid-washed quartz grains, Moved the cycle and then leave a period of 20 min, preheat role for 5 min for boiling, Preheat back for 30 min followed added after 1 ml of acidic acid (4 ml of $HClO_4$ acid and 96 ml of H_2SO4), Stir the mixture, then heat for 10 min, noticing that the mixture becomes clear after 5 min, cool the mixture Then pour into a volumetric flask measuring 50 mL, then top off with distilled water using strandard method, 2005, Atomic absorption spectrometer (AA7000,Shimadzu ,Japan). was used to evaluate Cu, , Mn, Fe, and Zn while PFP7 flame photometry was used to assess Na, Ca and K. (PFP7,Jenway). while Mg was measured by strandard method (2005).

2.6. Preparation of bread

Trejo-González et al. (2014) baked blend formulation using the straight dough methods and the following baking formula: 300 g wheat flour, 15 g sugar, 20.1 g shortening, 10.5 g dry yeast,180 ml waterand3 g salt (the study intends to replace tomato seed flour instead of wheat flour by2, 4and 7% to produce pan bread). The dough was combined for 4 minutes, rose for 30 minutes, punched for five minutes, and then raised for an additional 30 min. The dough was divided, pressed for a further 5minutes, formed and rounded. It was then put in baking pans and given a 60-minutes rise time at 30°C. . loaves were baked at 250°C for 10 minutes. before evaluation, the pan bread samples were given roughly an hour to cool on racks.

2.7. Sensory evaluation

For sensory evaluation, pan bread samples were classified and given to a 10 person panel of judges who are familiar with the product. The panelists rated the bread on a hedonic scale with nine points, with nine is the number "very like" and one representing "extremely dislike," for flavor, color, odor, texture, and overall acceptability (Udofia *et al*.,2013).

2.8. Statistical analysis

SPSS (2019) was used to assess these suits, and LSD at level 5% was used to analyze the test results.

3. Results

Table 1 contains the tomato flours' approximate composition values.As can be seen from Table.The tomato seed flour had higher levels of Protein(31.66%) and fat (20%)respectively. whereas the had lower levels of moisture (11.33%) and ash (3.16) respectively. Additionally, the findings demonstrate that the TSF contain (35.5%) Carbohydrate

Table 1. Proximate analysis of tomato seed flour

properties (%)	tomato seed flour
Moisture	11.33
Protein	31.66
fat	20
ash	3.16
Carbohydrate	35.5

An important source of proteins that can be used to improve nutrition is tomato seeds in line with the resuits of Mironeasa *et al*. (2019). who found that 6.94%moisture, 29.50% protein , 19.50%fat and 3.92%.

3.1. Fuctional properties

Table.2 showed fuctional properties of tomato seed flour.The tomato seed flour had water retention capacitiy was 3.43 g/g with the tomato seed flour having the high capability, which is explicable given the high concentration with fibers. This is most likely caused by the seed flour's higher fiber content and higher proportion of bigger particles. Water holding capacity is the volume of water that the fibrous matrix can hold (Nguyen et al.,2019) tomato seed flour was used as a component in meat items such breads and cakes due to their great water-holding capacity.

Table 2. Fuctional properties of tomato seed flour

Fuctional properties	tomato seed flour
Water retention capacity water g/ g	3.43
Oil retention capacity oil g/ g	2.13
Swelling index (%)	57.33

On the hand other, oil retention capacitiy was 2.13 g/g .higher oil absorption rate flour serve as flavor retainers and enhance food flavor and texture (lzidoro et al.,2023). These retention capabilities matched those that other investigations using vegetable flours had shown. According to González et al. (2011), tomato peel flour contains 6.76±0.21 gwater /g and 1.46±0.06 goil /g.

3.2. Minerals determination

Table 3displays the elements that make up tomato seed flour. Table's description of the tomato seed flour's mineral was better in every micro -element.The elemental Zn, Mn and Fe are the main constituent elements while Na , Mg, Cu, P and Ca seem to be other less common elements. According to Sayed et al.(2014).

Table 3. Seed tomato flour's macro- and micro-mineral concentrations mg/g

macro-mineral	Seed tomato powder
P	7.06
Mg	29
Ca	0.76
micro-mineral	
Na	15.7
Zn	57.645
Fe	72.28
Mn	75.77
Cu	14,205

Potassium is a necessary nutrient and plays a significant role in the synthesis of proteins and amino acids, which aids in the repair of damaged tissues. Calcium , on the other hand, is a key component of bone and aids in the development of teeth. These findings are supported by those Knoblich et al., (2005) who discovered that tomato seeds contains(0104 g/ kg^{-1}) Ca, (0.24 g/ kg^{-1}) Mg ,15.3 g/ kg^{-1}) P, (02.8 g/ kg^{-1}) Na, (242.6 g/ kg^{-1})Fe, (37.1g/ kg^{-1})Zn and (25.4g/ kg^{-1})Mn

3.3. Amino acid determination

Table 4 lists the amino acid composition of seed tomato powder. The three main amino acids in seed tomato powder was discovered to be, glutamic acid(320.8µg/ g), aspartic acid (285.9 µg/ g) and Lysine (166.88µg/ g).

Figure 1. Amino acids conent of tomato seed flour in µg/ g

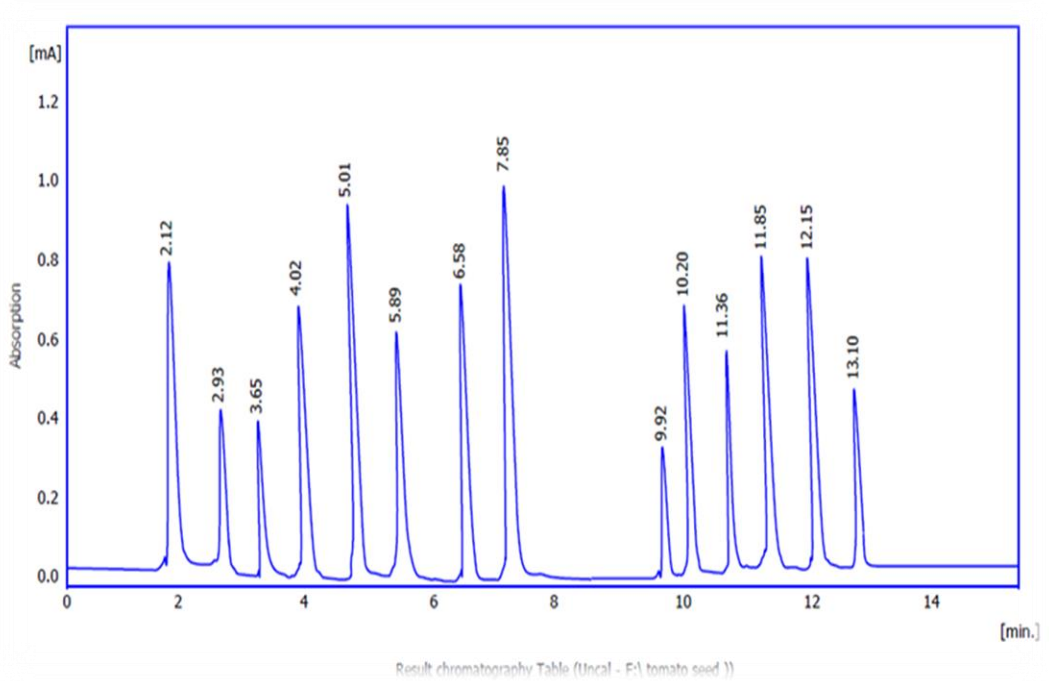

Table 4. Amino acids conent of tomato seed flour in µg/ g

Result chromatography Table (Uncal - F:\ tomato seed))

No	Reten. Time [min]	Area [mAU.s]	Amount [µg / gm]	Type peak	Calculation	Compound Name
1	2.12	3952.28	166.8	Order	Calibration carve	Lysine
2	2.93	1625.49	48.9	Order	Calibration carve	Methionine
3	3.65	1520.14	136.0	Order	Calibration carve	Tryptophan
4	4.02	2561.08	142.9	Order	Calibration carve	Arginine
5	5.01	3698.59	95.8	Order	Calibration carve	Threonine
6	5.89	4215.66	94.0	Order	Calibration carve	Valine
7	6.58	4158.97	55.9	Order	Calibration carve	Isoleucine
8	7.85	9521.46	79.8	Order	Calibration carve	Lucien
9	9.92	1230.56	121.4	Order	Calibration carve	Phenylalanine
10	10.20	1985.65	320.8	Order	Calibration carve	Glutamic acid
11	11.36	1745.08	285.9	Order	Calibration carve	Aspartic acid
12	11.85	2564.88	159.5	Order	Calibration carve	Histidine
13	12.15	2631.09	89.0	Order	Calibration carve	Serine
14	13.10	1254.88	52.4	Order	Calibration carve	Proline
	Total					

According to data in table.4, the sulfur amino acid methionine (48.9 µg /g was the limited amino acids. on the other hand. The tomato seed flour , appears to be abundant in Tryptophan (136. µg / g) , Lucien (79.8 µg /g), Isoleucine (55.9 µg / g) Arginin(142.9 µg / g) , valine (94.09 µg / g) , histidine (159.5 µg / g) , and phenylalanine (121.4 µg /g). These findings support the findings of Knoblich et al. (2005) who said that seed on dry basis were glutamic acid(29.5 g / kg^{-1}), aspartic acid (15.1 g / kg^{-1}) , Lucien (7.8 g / kg^{-1}) and Lysine (6.1 g / kg^{-1}).

3.3. Sensory evaluation

The resuits of the sensory evaluation in table5 and figure.2 showed that there are substantial changes between the control sample and the bread containing tomato seeds at various levels. results indicated that variations in bread crumb color. according to the findings, adding TSF to the recipe for bread diminishes bread lightness due to the darker TSF color relative to white wheat flour . higher scores were given to the sample containing up to 2% TSF. the increasing level of TSF had a negative influence on aroma , texture and taste all suffered with the addition of increasing amounts of TSF 7%.

Table 5. Sensory evaluation of bread contain tomato seeds

levels	Taste	Colour	Aroma	Texture	Accept
0%	7.98a	8.35a	8.26a	8.43a	8.28a
2%	8.29a	8.03a	8.49a	8.48a	8.35a
4%	8.57ab	7.06b	8.60ab	8.47a	8.43a
7%	6.1c	5.27c	6.59c	8.62a	8.34 ab
	*	*	*	ns	significant level

Udofiaet al.,(2013)

Figure 2. Breads made using tomato seed flour

0% 2% 4% 7%

Figure 2 shows how representative breads made using tomato seed flour of wheat and wheat flour look. The percentage of tomato seed flour replacement is shown by the numbers.

TSF's addition to wheat bread enhanced the crumb grain by preserving the dough's air cells and stopping the cells from coalescing (Mironeasa *et al*. ,2019) .As the TSF level rose, the taste, colour, aroma and accept score decrease. The resuits indicated that the sample with 7% TSF compared to the group with 2% TSF, earned decrease scores. A steroid molecule present in crushed tomato seed may be the cause of a little bitter flavor at greater addition levels (Mironeasa *et al.,*2019).

Similar findings were made by Mironeasa *et al*. (2019) who found that the increasing level of TSF had a favorable influence on bread texture containing up to 10% while higher TSF addition rates (15 and 20%) had a negative impact on texture.

4. Conclusions

Consuming bread contain Tomato seed had high nutritional qualities can help avoid diabetes, heart disease, and some types of cancer. the tomato seed flour had higher concentraction of proteins, lipids, essential amino acids such glutamic acid, aspartic acid and lysine and minerals such P, Ca, Zn , Fe andCu. As a result, the tomato seed flour under investigation may be suggested as a nutrient source in to bread formulation . this study shown that TSF can substitute wheat flour in bread production up to a level of 2% with only a minimal impact on the sensory properties of bread. The inclusion of tomato seeds in the diet of humans may also help to reduce environmental pollution issues and raise the value added of wastes.

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