

Evaluation of toast and baton sale enhanced by some nutritional ingredients

Ibrahim MA Ibrahim^{1*}, Marwa M Shaheen¹, Ensaf M Khalil¹, Ekram H Barakat²

¹ Special Food and Nutrition, Department Food Technology Research Institute, Agricultural Research Center, Giza, Egypt

² Department of Home Economics, Faculty of Specific Education, Kafr elsheikh University, Kafr El-Sheikh, Egypt

Abstract

In the field of food studies, the evaluation of different foods goes beyond sensory characteristics such as taste and texture to include their nutritional value and health effects. This study presents a new method for developing toast and baton sale products by incorporating various nutritional ingredients with high health and nutritional value by replacing 10% of whole wheat flour with a mixture containing (sesame, peanuts, chickpeas, coriander, chia seeds, pumpkin seeds, rosemary, and thyme) to improve the quality of them and provide new nutritional and health benefits. The composition of the raw materials used to fortify toast and baton sale was evaluated. The sensory, physical, and chemical properties of toast and baton sale were determined. Fortification increased the protein content in toast to 4.96% and up to 11.39% in baton sale compared to the control sample made from whole wheat flour alone without any fortifying agents. The fat, mineral, and fiber content in toast and baton sale increased by (117.5% and 151.77%), (24.38% and 41.17%), (11.56% and 11.31%), respectively. The carbohydrate content in toast decreased by 6.89%, while the decrease in baton sale was 7.28%. The calories produced from toast increased by 2.40% and by 3.17% in baton sale. As for minerals such as calcium, sodium, magnesium, potassium, iron, zinc, phosphorus, and manganese, their content in toast and baton sale increased by (153.05 and 268.09%), (118.58 and 361.89%), (12.35 and 25.43%), (11.53 and 31.29%), (39.84 and 127.72%), (8.24 and 16.82%), (2.16 and 2.22%), (-2.98 and 3.02%), compared to the control group. Despite the good sensory characteristics of toast and baton sale fortified with 10% fortifying agents, the overall acceptance of the control group exceeded that of toast by 10.2% and baton sale by 13.5%. However, we recommend increasing the consumption of fortified toast and baton sale compared to non-fortified products to increase nutritional and health value and meet many of the functional needs of the human body.

Keywords: Fortification, nutritional value, toast and baton sale, sensory evaluation, functional ingredients

Introduction

Increased consumer awareness and interest in health, wellness, and nutrition has led to growing demand for foods that promote health and prevent disease, known as functional foods. Their physiological benefits are attributed to their biologically active components, such as phytochemicals, dietary fiber, and proteins. Consuming these foods improves consumers' nutritional status and reduces the risk of certain degenerative diseases, thereby lowering healthcare spending (Sun *et al.* 2002, Oboh *et al.* 2007) [31, 41]. Baked goods made from wheat flour, such as toast and baton sale, are very popular, despite the low protein, fiber, and mineral content of wheat flour, which causes health problems (Young, 2001) [46], especially if they are made from refined wheat flour, which does not adequately meet the requirements for many macronutrients or micronutrients (Nadeem *et al.*, 2010) [27]. Toast and baton sale are a rich source of carbohydrates and energy. However, their nutritional value is often low, as they are mainly made from wheat flour (Soukoulis *et al.* 2014; Notarnicola *et al.* 2017) [30, 40]. The preparation of bakery products is mainly based on refined flour, which contains high amounts of simple sugars. These amounts can be reduced by enriching them with ingredients that have positive health effects, such as fiber, proteins, vitamins, minerals, and antioxidants (Ferrari *et al.*, 2022; Chockchaisawasdee *et al.*, 2023; Crucean *et al.*, 2023) [12, 14, 19]. This has prompted researchers to introduce nutritional

improvements to enhance nutritional properties without negatively affecting sensory, technological, or nutritional characteristics. Reducing the proportion of white flour in bakery products by replacing it with healthier ingredients is crucial from a health and nutritional standpoint, as it limits the negative effects of white flour, which is considered a "simple carbohydrate" with a high content of simple sugars. Reducing the proportion of white flour in bakery products limits the negative effects of simple carbohydrates with a high glycemic index, which raise blood sugar levels, increasing the risk of insulin resistance, high triglyceride levels in the blood, and obesity. Increased consumer awareness has prompted industries to prepare baked goods that contain natural, unrefined ingredients, are low in sugar, fat, and calories, and are rich in minerals, vitamins, and dietary fiber (Agarwal *et al.*, 2016). Adding fiber improves digestion and increases satiety while improving bowel movements and preventing constipation, as well as promoting the growth of beneficial bacteria in the gut and reducing the absorption of fat and harmful cholesterol. The amount and type of fiber added are important factors in the production of baked goods, as they can affect the final product and its physical, chemical, and sensory properties (Baba *et al.* 2015) [10]. Baton sale and toast can be enriched with products containing high concentrations of dietary fiber, which promote health benefits for consumers related to gastrointestinal, cardiovascular, and metabolic diseases (Almeida *et al.* 2013) [5, 6]. Dietary fiber is also an important

component of the functional properties of baked goods and can be used to modify the physical, chemical, and sensory properties of fiber-fortified food products (Aydogdu *et al.* 2018) [9]. Grain-based products play a fundamental role in the daily diet of people of all ages and backgrounds around the world, providing a good source of fiber, protein, nutrients, vitamins, and antioxidants (Du *et al.*, 2022; Wrigley, 2016) [43]. Many of these rich ingredients can be obtained from food preparation by-products, providing an alternative to their destruction, with environmental and economic benefits (Martins *et al.*, 2017 [26]; Oyediji and Wu, 2023) [33]. Proteins enhance nutritional value, while minerals and vitamins such as including calcium, iron, and vitamin D support daily requirements. In recent years, whole grain products have gained popularity due to higher levels of dietary fiber, minerals, and bioactive components (Gong *et al.*, 2018) [21]. Seeds or grains (such as flax, chia, and sesame seeds) can be added to provide healthy fats and omega-3s. In this context, the aim of this study was to evaluate the effect of partially replacing 10% of whole wheat flour with a mixture of highly nutritious and healthy ingredients such as sesame, peanuts, chickpeas, coriander, chia seeds, pumpkin seeds, rosemary, and thyme on the physical,

chemical, and sensory properties of toast and baton sale, and to determine the chemical properties of the most acceptable formulations in sensory analysis, with the aim of verifying the feasibility of a new product and stimulating the sustainable production of baked goods.

Materials and methods

Materials

Whole grain flour of wheat, diverse ingredients like sesame, peanuts, chickpeas, coriander, chia seeds, pumpkin, rosemary, and thyme, and traditional ingredients like yeast, salt, water, and vegetable oil, was procured from Cairo's local markets.

Methods

Sample preparation

The control sample was made from whole grain wheat flour, and the fortified ingredients (sesame powder, peanuts powder, chickpeas powder, coriander powder, cumin powder, chia seeds powder, pumpkin seeds rosemary powder, and zaater powder) were substituted with 10% of the whole grain wheat flour for making toast and baton sale samples as shown in Table 1.

Table 1: Formulation for added ingredients for toast bread and baton sale

Ingredients(g)	Toast					Ingredients	Baton sale				
	Control	1	2	3	4		Control	1	2	3	4
Whole grain flour	100	90	90	90	90	Whole grain flour	100	90	90	90	90
Sesame seeds		2	2	2	2	Sesame seeds	-	2	2	2	2
Peanut		1.60	1.60	1.60	1.60	Peanut	-	1.60	1.60	1.60	1.60
Chickpea flour		1.60	1.60	1.60	1.60	Chickpea flour	-	1.60	1.60	1.60	1.60
Coriander		1.60	1.60	1.60	1.60	Coriander	-	1.60	1.60	1.60	1.60
Cumin powder		1.60	1.60	1.60	1.60	Cumin powder	-	1.60	1.60	1.60	1.60
Chia Seeds powder		1.60	-	-	-	Chia seeds powder	-	1.60	-	-	-
Pumpkin seeds		-	1.60	-	-	Pumpkin seeds	-	-	1.60	-	-
Rosemary powder		-	-	1.60	-	Rosemary powder	-	-	-	1.60	-
Zaater powder		-	-	-	1.60	Zaater powder	-	-	-	-	1.60
Salt	0.5	0.5	0.5	0.5	0.5	Salt	2	2	2	2	2
oil	3	3	3	3	3	oil	15	15	15	15	15
Suger	1	1	1	1	1	Butter	15	15	15	15	15
Instant yeast	3	3	3	3	3	Instant yeast	4	4	4	4	4
Warm water(ml)	40	40	40	40	40	Warm water(ml)	40	40	40	40	40
Baking powder	0.5	0.5	0.5	0.5	0.5	Cumin seeds	5	5	5	5	5
Sodium bicarbonate	0.5	0.5	0.5	0.5	0.5						

Toast and baton sale processing

The dry ingredients were weighed and mixed by hand, then water was added gradually. The mixture was then homogenized and kneaded by hand for 15 minutes before being shaped (for toast, the dough is divided into 100 g pieces, each piece placed in an oiled aluminum tray (150 mm × 40 mm × 40 mm) and left to ferment for 45 minutes. For baton sale, the dough was shaped into long sticks and left to ferment, then sprinkled with cumin. The toast was baked in an industrial oven preheated to 180°C for 25 minutes. As for the baton sale, it is baked in a medium-temperature oven until cooked. The baton sale preparation is now completed, as per (Yossef and El-Sheikh, 2008) [45]. Toast is cooled, then sliced (10 mm thick slices), toasted (at 150°C for 20 minutes), cooled again (at room temperature), and thus the preparation of toast is complete according to (Emannuele *et al.*, 2020). It is then packaged and stored in low-density polyethylene bags, sealed tightly, and stored at room temperature until analysis.

Physicochemical properties

The toast's mass was determined using a sensitive balance. The displacement technique and 20 replicates per replicate were used to estimate volume with millet seeds. The methods suggested by AOAC (2012) [8] allowed for the calculation of the specific volume by dividing the mean volume by the mass of the samples. The density was determined by dividing mass by volume.

Proximal composition and total energy value

According to AOAC (2012) [8] recommendations, the approximate composition of toast and baton sale was determined. Ash was estimated after combustion at 550 °C in a muffle furnace. Nitrogen was estimated using the Kjeldahl method with a distiller, and a factor of 6.25 was used to determine crude protein content. The fat was determined through the continuous extraction of petroleum ether using a Soxhlet extractor. The enzymatic-gravimetric

method was used to determine the amount of dietary fiber, which is both soluble and insoluble. Based on De Menezes *et al.*, (2016), the available carbohydrates and total energy value were calculated. The difference between 100 and (ash, protein, fat, and dietary fiber) was used to calculate the available carbohydrate content. To calculate the total energy value, we multiplied fat by 9, protein and carbohydrate by 4, and dietary fiber by 2.

Mineral's analysis

As outlined in the AOAC (2005) methodology, the elemental analysis of calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), zinc (Zn), iron (Fe), and manganese (Mn) was conducted through the utilisation of atomic absorption spectroscopy technology. The phosphorus content was assessed through the measurement of the optical density at a wavelength of 650 nm, employing the methodology outlined by Ranganna (1978) [36].

Sensory evaluation

Toast and baton sale were evaluated for taste, appearance, crumb texture, crumb grain, odor, crust color, and overall acceptability.

Sensory evaluation scores were given on a scale of 1 to 10, and the average of all evaluated characteristics was used to represent overall acceptability (Smith *et al.*, 1972) [39]. A training committee consisting of ten members from among the students and staff of the Department of Home Economics at the Faculty of Specific Education, Kafr elsheikh University was selected based on their experience and knowledge to conduct the sensory evaluation. The tests were conducted under fluorescent lighting in the nutrition laboratory, and the sensory evaluation was conducted at 10 a.m. Between evaluations, mouth rinsing was done with tap water.

Statistical analysis

The outcomes were presented as mean. The results were analyzed using one-way classification. The statistical analysis for all data was done with the analysis variance (ANOVA) test, the least significant difference (L.S.D) at 0.05, and Duncan's test. The analysis of variance technique was utilized in all statistical analyses using Co STATE Computer software.

Results and discussion

Table 2: Chemical composition of raw materials (g/100g)

Raw materials	Crude protein	Crude ether extract	Ash	Fiber	Available carbohydrates
Whole grain flour	13.50 ^f	2.60 ^h	1.80 ^f	11.90 ^e	70.20 ^a
Sesame seeds	17.50 ^e	49.60 ^a	4.50 ^d	14.90 ^d	13.50 ^h
Peanut	24.90 ^b	48.01 ^a	1.75 ^f	9.01 ^g	16.33 ^g
Chickpea flour	22.50 ^c	6.35 ^g	2.90 ^e	3.60 ⁱ	64.65 ^b
Coriander	12.37 ^g	17.90 ^d	5.80 ^c	41.90 ^a	22.03 ^f
Cumin powder	18.00 ^e	23.80 ^c	7.60 ^b	10.49 ^f	40.11 ^c
Chia seed powder	19.60 ^d	29.92 ^b	4.70 ^d	31.75 ^c	14.03 ^h
Pumpkin seeds	30.80 ^a	48.90 ^a	4.50 ^d	6.60 ^h	9.20 ⁱ
Rosemary powder	4.88 ⁱ	15.22 ^e	7.10 ^b	42.60 ^a	30.20 ^e
Zaater powder	9.10 ^h	7.40 ^f	9.90 ^a	36.90 ^b	36.70 ^d

Mean followed by the same letter in the same column do not differ statistically by Duncan test at 5% probability

Table 2 displays the chemical composition of the raw materials utilized in the production of baton sale and toast. It is worth noting that the protein content of whole wheat flour was 13.5 grams per 100 grams. It should be noted that the protein content in all ingredients used to fortify toast and baton sale was higher than that found in whole wheat flour, as in sesame, peanuts, chickpeas, cumin, chia seeds, and pumpkin seeds, while it was lower in coriander, rosemary, and thyme. The protein content in pumpkin seeds was the highest at 30.80%, followed by peanuts at 24.9%, and rosemary had the lowest protein content among all additives at 4.88%. All additives used had higher fat content than that found in whole wheat flour, which was 2.6%. Sesame seeds and peanuts were the top source of added oil, while chickpeas were the lowest. The ash content of all additives or fortified ingredients we employed was higher than that of wheat flour 1.80%, with the exception of peanuts, which had a lower ash content of less than 1.75%, which was not a significant difference. When it comes to crude fiber, it's worth noting that some additives contain more fiber than whole wheat flour. The fiber content of these ingredients is 14.9% for sesame seeds, 41.9% for coriander, 31.75% for chia seeds, 42.6% for rosemary, and 36.9% for thyme. The fiber levels in the remaining additives were lower than those in whole wheat flour. There is an emerging trend of supplementing dietary fibers and minerals within baked

products, with the objective of enhancing their nutritional value. This approach is underpinned by scientific evidence associating their consumption with a reduced risk of cancer, type 2 diabetes, obesity, heart disease, and chronic respiration disorders (Schwingshackel *et al.*, 2015). It is evident that an adequate intake of dietary fiber contributes substantially to sustaining a healthy digestive system, regulating blood glucose levels, and inducing satiation, thereby facilitating effective weight management. As demonstrated in the research by Ciudad-Mulero *et al.* (2019) [13], dietary fiber has been associated with a number of health benefits, including the prevention of colonic diverticulosis, hypocholesterolemia, constipation, and digestive processes. Furthermore, minerals play a crucial role in numerous physiological processes, including bone health, immune system function, and the proper functioning of nerves and muscles. The percentage of carbohydrates in all the additives used to fortify baton sale and toast was lower than in whole wheat flour, which reached 70.20%, as we observed. The amalgamation of raw ingredients, each with distinct functional properties, is poised to yield novel products. These products, in turn, will catalyze transformative inventions within the domain of natural food products, thereby conferring benefits upon public health and the prevention of numerous diseases (Butu and Rodino, 2019) [11].

Table 3: Mineral's content of raw materials flour (mg/100g on dry weight basis).

Minerals (mg/100g)	Calcium (Ca)	Sodium (Na)	Magnesium (Mg)	Potassium (K)	Iron (Fe)	Zinc (Zn)	Phosphorous (P)	Manganese (Mn)
Whole grain flour	40.0 ^e	3.50 ^f	140.00 ^g	430.00 ^f	4.00 ^e	2.90 ^g	400.00 ^d	4.00 ^b
Sesame seeds	700.0 ^c	7.50 ^e	350.00 ^c	450.00 ^e	14.00 ^c	6.50 ^b	600.00 ^c	2.50 ^f
Peanut	60.0 ^e	9.00 ^d	180.00 ^f	650.00 ^d	1.50 ^f	3.50 ^f	400.00 ^d	2.00 ^g
Chickpea flour	163.0 ^d	29.90 ^b	165.00 ^g	803.00 ^e	6.09 ^d	5.16 ^c	275.00 ^e	3.09 ^d
Coriander	709.0 ^c	34.00 ^b	265.00 ^d	1270.00 ^b	18.00 ^b	4.50 ^d	485.00 ^d	2.10 ^g
Cumin powder	920.0 ^b	170.00 ^a	367.00 ^b	1700.00 ^a	70.00 ^a	4.90 ^c	4.90 ^h	3.40 ^c
Chia seed powder	660.0 ^c	19.00 ^c	330.00 ^c	445.00 ^e	8.00 ^c	5.00 ^c	850.00 ^b	2.12 ^g
Pumpkin seeds	45.0 ^e	7.00 ^e	540.00 ^a	800.00 ^e	8.50 ^c	7.00 ^a	1125.00 ^a	4.30 ^a
Rosemary powder	650.0 ^c	25.00 ^b	155.00 ^g	300.00 ^g	8.00 ^c	1.70 ^h	70.00 ^g	2.80 ^e
Zaater powder	1350.0 ^a	30.00 ^b	240.00 ^e	750.00 ^e	12.00 ^c	2.50 ^g	120.00 ^f	1.50 ^h

Mean followed by the same letter in the same column do not differ statistically by Duncan test at 5% probability

Table 3 displays the mineral composition of the raw materials used to make baton sale and toast. The substances used to enhance baton sale and toast had higher concentrations of Calcium, sodium, magnesium, and potassium, which are the four basic elements mentioned in the table.

Calcium is a mineral that is essential for human health and well-being. The human body requires significant amounts of calcium to function optimally. Calcium is the most abundant element in the human body, comprising 90% of the components of bones and teeth. It is imperative for the maintenance of optimal health, particularly in regard to the muscular, circulatory, and digestive systems, as well as the formation of bones and the synthesis and function of blood cells. Furthermore, it has been associated with various biological processes, including growth and development, hematopoiesis, clotting, nerve signaling, muscle relaxation, and contraction (Narvaez Andino and Reyes Toval, 2013) [28]. The average estimated requirement (EAR) for calcium for a pregnant woman is at least 1 gram. A diurnal dosage of 1.3 grams of calcium is regarded as highly acceptable for children between the ages of 9 and 18, with the recommendation being reduced in elderly individuals until it reaches 1 gram per day to avert osteomalacia. Additionally,

women over the age of 50 require 1.2 grams per day of calcium (Gonzalez Sanchez *et al.*, 2012) [22]. The amount of calcium obtained from food sources does not exceed the recommended daily intake (Aballay, 2012) [1]. Consequently, insufficient calcium intake can lead to osteoporosis and an elevated risk of fractures, particularly among postmenopausal women (Zamudio *et al.*, 2015) [47]. Consequently, it is recommended to increase the consumption of calcium-rich foods or nutritional supplements. Concerning iron content, it was found that all ingredients used to fortify baton sale and toast had higher iron levels compared to whole wheat flour, which was 4 mg per 100 grams, with the exception of peanuts, which had an iron content of 1.5 mg per 100 grams. Rosemary and thyme were the only raw materials with lower zinc content than whole wheat flour. Whole wheat (400 mg/100 g) ranked higher in phosphorus content than any other ingredients used to reinforce baton sale and toast, with the exception of sesame seeds, peanuts, coriander, chia, and pumpkin seeds. When it comes to magnesium, baton sale and toast's fortified ingredients contained lower levels compared to whole wheat flour (4 mg/100 g), with the exception of pumpkin seeds, which had a 4.3 mg/100 g magnesium level.

Table 4: Chemical composition and total energy of toast bread and baton sale (g/100g).

	Toast					
	Crude protein	Crude ether extract	Ash	Fiber	Available carbohydrates	Caloric value (Kcal/100g)
Control	12.50 ^d	2.40 ^d	1.60 ^d	10.90 ^e	72.60 ^a	383.8 ^e
T1	12.95 ^b	4.94 ^b	1.92 ^c	11.58 ^d	68.61 ^b	393.86 ^b
T2	13.12 ^a	5.22 ^a	1.90 ^c	12.16 ^a	67.60 ^c	394.18 ^a
T3	12.75 ^c	4.72 ^c	1.94 ^b	11.73 ^b	68.86 ^d	392.38 ^c
T4	12.81 ^b	4.61 ^c	1.99 ^a	11.65 ^c	68.94 ^d	391.79 ^d
Blends	Baton sale					
	Crude protein	Crude ether extract	Ash	Fiber	Available carbohydrates	Caloric value (Kcal/100g)
Control	10.98 ^c	1.97 ^d	1.36 ^d	9.02 ^e	76.67 ^a	368.33 ^d
B1	12.09 ^a	4.96 ^b	1.86 ^c	9.91 ^c	71.18 ^c	377.72 ^b
B2	12.23 ^a	5.19 ^a	1.88 ^c	9.61 ^d	71.09 ^d	379.99 ^a
B3	11.92 ^b	4.78 ^c	1.90 ^b	10.04 ^a	71.36 ^b	376.14 ^c
B4	11.97 ^b	4.69 ^c	1.92 ^a	9.97 ^b	71.45 ^b	375.89 ^c

Table 4 Chemical composition of baton bread and toast

Mean followed by the same letter in the same column do not differ statistically by Duncan test at 5% probability

Regarding toast and Patton-Salé, it should be noted that all treatments used resulted in increased protein, fat, ash and fiber content in toast and Patton-Salé compared to the control group to which no boosters were added. According to the protein, dietary fiber and mineral content in Table 4, foods resulting from different fortification treatments in

baton sali and toast can be classified as rich in these nutrients, as shown by (Okpala and Egwu, 2015) [32]. Therefore, toast containing protein, dietary fiber and minerals provides high nutritional and functional value. It is worth noting that the maximum increase in protein content in the control-enhanced samples was in the T2 sample,

where the increase rate reached 4.96% in toast, while the maximum increase in protein content in the B2 sample in baton sale reached 11.39%. The maximum increase in fat content was recorded in toast samples in sample T2, with an increase of 117.5%, compared to an increase of 150.77% in sample B2 in baton-salé. The highest increase in samples enhanced in mineral elements in toast was in sample T4 by 24.38% while it was by 41.17% in baton sale in sample B2. Regarding fiber, the highest percentage of fiber increase was recorded in sample T2 in toast at 11.56%, while in sample B3 in baton sale it reached 11.31%. Adequate dietary fiber consumption helps control blood cholesterol levels, diabetes, cardiovascular and gastrointestinal diseases, obesity, and prevent colon cancer (Goshal *et al.* 2016). It also improves constipation and prevents digestive problems (Huang *et al.* 2015) [24]. The importance of dietary fiber has prompted the food preparation industry to develop a variety of fiber-rich products and ingredients to improve the nutritional and functional quality of foods (Dhingra *et al.*

2012) [17]. Cellulose is insoluble in water found in fiber and affects the composition of bread and leads to numerous changes in bread quality characteristics (Poran *et al.*, 2008) [35]. It increases the viscosity of the liquid flour mixture because it is insoluble in water, resulting in a stronger gaseous structure. Thus, air bubbles will remain small in size and will not float to the surface of the liquid, resulting in fine air bubbles, larger foam volume, and better stability (Wongsunsarim *et al.*, 2001). All treatments also significantly reduced carbohydrate content compared to the control group, with the maximum carbohydrate reduction in treatment T4 in toast reaching 6.89%, while the maximum reduction in baton sale in treatment B2 reached 7.28%. Despite the increase in calories resulting from the enhanced treatments compared to the control group due to the addition of fat to the formula of fortified toast and baton sale, the increase in energy was slight, as the highest increase in toast in sample T2 reached 2.4%, while in baton sale it reached 3.17% in sample B2.

Table 5: Mineral's content of toast bread and baton sale (mg/100g on dry weight basis).

	Toast bread					Baton sale				
	Control	T1	T2	T3	T4	Control	B1	B2	B3	B4
Calcium (Ca)	36.87 ^d	83.12 ^b	74.06 ^c	82.98 ^b	93.30 ^a	30.30 ^d	102.97 ^b	95.72 ^c	103.05 ^b	111.53 ^a
Sodium (Na)	3.23 ^d	6.89 ^c	6.72 ^c	6.98 ^b	7.06 ^a	2.65 ^d	12.11 ^c	11.96 ^c	12.18 ^b	12.24 ^a
Magnesium (Mg)	129.03 ^c	141.87 ^b	144.97 ^a	139.29 ^d	140.54 ^c	106.06 ^d	130.52 ^b	133.03 ^a	128.39 ^c	129.42 ^c
Potassium (K)	396.31 ^c	436.76 ^b	442.00 ^a	434.63 ^b	441.26 ^a	325.76 ^c	423.40 ^b	427.70 ^a	421.64 ^b	427.10 ^a
Iron (Fe)	3.69 ^d	5.11 ^c	5.12 ^b	5.11 ^c	5.16 ^a	3.03 ^c	6.89 ^a	6.85 ^b	6.80 ^b	6.90 ^a
Zinc (Zn)	2.67 ^c	2.87 ^b	2.89 ^a	2.81 ^d	2.83 ^c	2.20 ^d	2.55 ^b	2.57 ^a	2.50 ^c	2.52 ^c
Phosphorous (P)	368.66 ^c	372.57 ^b	376.63 ^a	361.07 ^d	361.00 ^d	303.03 ^c	306.42 ^b	309.76 ^a	296.97 ^d	297.58 ^d
Manganese (Mn)	3.69 ^a	3.53 ^c	3.58 ^b	3.50 ^d	3.53 ^c	2.98 ^e	3.05 ^b	3.07 ^a	3.01 ^d	3.03 ^c

Mean followed by the same letter in the same column do not differ statistically by Duncan test at 5% probability

Table 5 illustrated, the mineral content of baton sale and toast.

It is important to acknowledge that the utilization of various treatments resulted in a notable increase in the levels of calcium, sodium, magnesium, potassium, iron, and zinc in both the toast and baton sales when compared to the control group. Treatment T4 in toast demonstrated a 153.05% increase in calcium, while treatment B4 in baton sale exhibited an increase of up to 268.09%. Sodium levels exhibited an increase of (118.58, 361.89%) in treatment T4 and B4 in both the toast and baton sale, respectively, while the increase reached (12.35, 25.43%) in T2 and B2 in magnesium. The increase in potassium was observed to be significant, with a range of 11.53% to 31.29% in T2, B2, 4, toast, and baton sales, respectively. Potassium has been demonstrated to offer numerous health benefits, including the reduction of stroke risk, the prevention of heart complications, and the mitigation of blood pressure. As indicated by Deborah *et al.* (2020) [16], the ingestion of potassium-rich foods has the potential to impede the progression of chronic kidney disease and mitigate the risk

of mortality in individuals afflicted with this condition. The increases in iron and zinc amounted to 39.84% and 127.72%, respectively, in samples T4 and B1, and to 8.24% and 16.82%, respectively, in samples T2 and B1. Notably, the elevated iron content plays a pivotal role in facilitating the synthesis of hemoglobin within the blood and red cells, which is particularly advantageous in cases of anemia. Additionally, iron facilitates protein metabolism and the proper functioning of the central nervous system. Zinc, an essential trace element, plays a pivotal role in the promotion of bone metabolism (Yamaguchi, 2015) [44]. A deficiency in zinc nutrients hinders bone development (Payal *et al.*, 2018) [34]. With regard to the analysis of phosphorus content, it was observed that treatments 1 and 2 resulted in an increase compared to the control group, which comprised untreated toast and baton sales. Conversely, treatments 3 and 4 led to a decrease in phosphorus content for both toast and baton sales. In the context of manganese, the treatments applied to the toast samples resulted in a reduction in magnesium content compared to the control group.

Table 6: Physical parameters of toast bread

	Weight (g)	Volume (Cm ³)	Specific volume (cm ³ /g)	Density (g/cm ³)
Control	339.15 ^b	693.00 ^d	2.04 ^d	0.49 ^a
T1	307.74 ^d	742.50 ^b	2.41 ^a	0.41 ^e
T2	352.16 ^a	836.00 ^a	2.37 ^b	0.42 ^d
T3	340.91 ^b	731.60 ^c	2.15 ^c	0.47 ^b
T4	321.46 ^c	692.00 ^d	2.15 ^c	0.46 ^c

Mean followed by the same letter in the same column do not differ statistically by Duncan test at 5% probability

According to the data presented in Table 6, the physical properties of toast are as follows:
 With respect to the variable of weight, it was observed that only treatment 2 resulted in an increase in weight in comparison with the control group. With regard to volume, it was observed that all treatments, with the exception of treatment 4, resulted in an increase in volume compared to the control group (693 cm³). Increasing the proportion of dietary fiber and minerals with protein and fat led to an increase in volume compared to the control, thus increasing the surface area and specific volume of the toast directly due to increased water retention. A change in the structural properties of the dough allowed for increased gas retention during fermentation and baking, which allowed for an increase in the volume in treatments T1, T2, and T3.

With regard to the specific volume of toast, it was observed that all treatments increased this parameter in comparison with the control group (2.4 cm³/g). The observed increase in weight, volume, and surface area may be attributed to the presence of various additives, which enhance the toast's capacity to retain moisture. This phenomenon may be attributed to its high-water absorption capacity, which is attributable to its substantial fiber content. This content has been observed to bind with water and thereby retain it (Maboh *et al.*, 2024) [25]. With regard to density, all treatments applied resulted in a reduction in density compared to the control (0.49 g/cm³). This may be attributable to the increase in volume observed in the treated samples compared to the control.

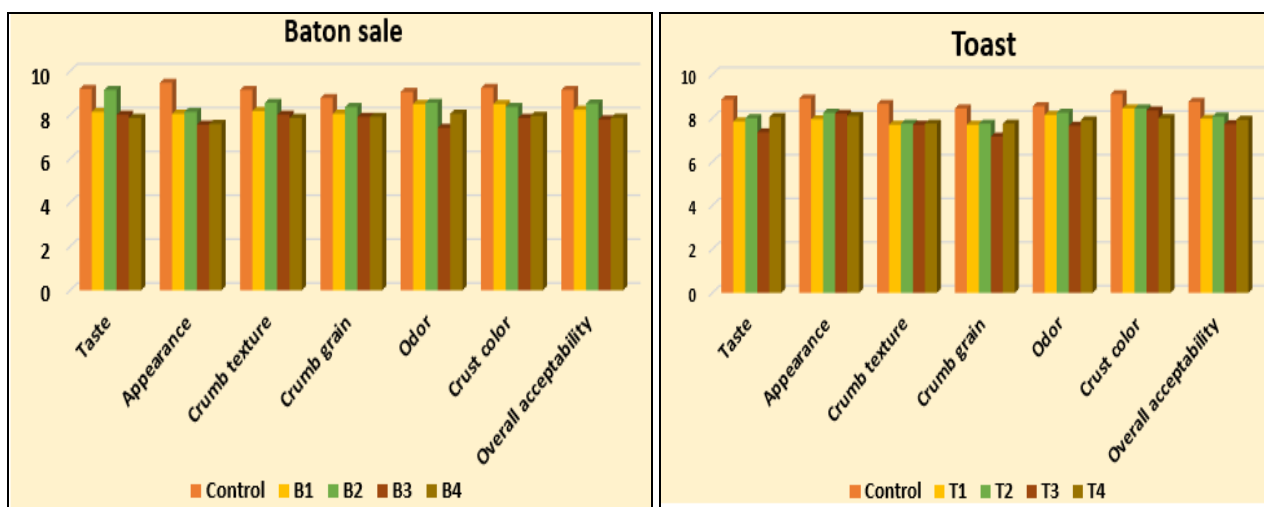
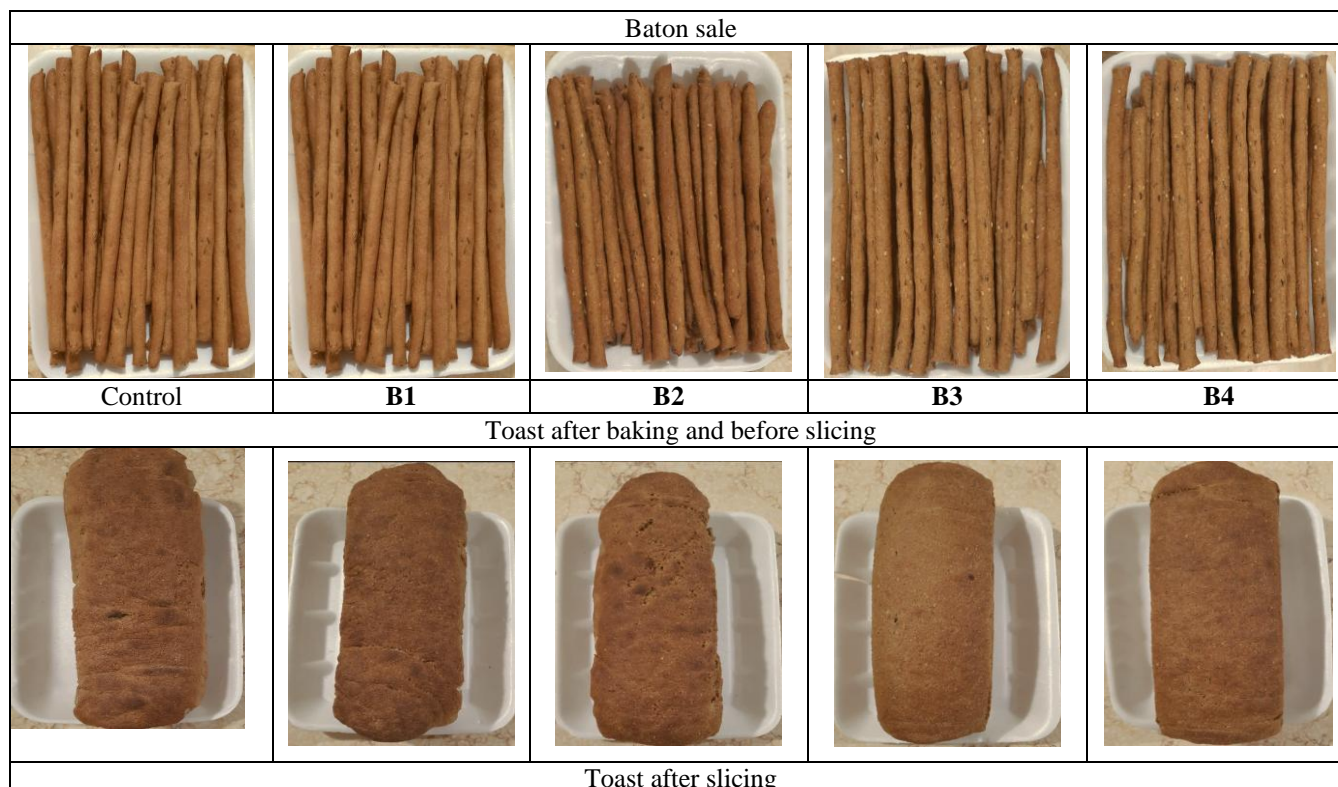


Fig 1: Sensory evaluation of baton sale and toast bread



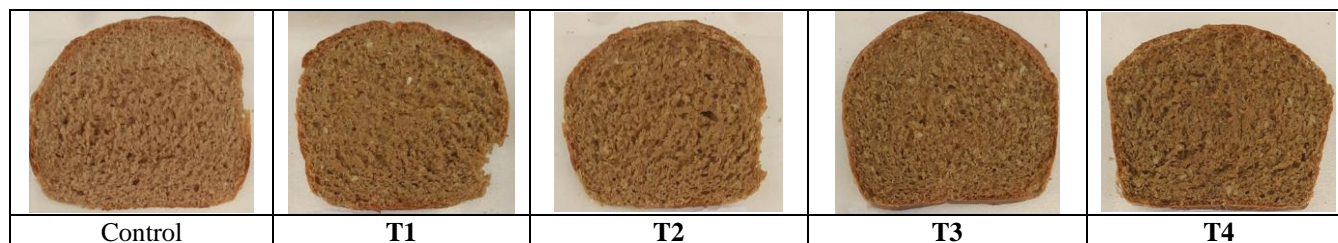


Fig 2: The various shapes of baton sale and toast obtained from different treatments.

As illustrated in Figure 1, and Figure 2 the sensory evaluation of baton sale and toast reveals notable differences in their respective sensory profiles. The control treatment, which incorporated wheat flour devoid of additives, exhibited superior performance in terms of sensory characteristics and overall acceptability when compared to all other treatments for both baton sale and toast. The incorporation of reinforcing materials into the treatments resulted in an augmentation of moisture content, which, in turn, led to an elevated fiber content, thereby enhancing water absorption. This may have exerted a deleterious effect by instigating undesirable alterations in texture, such as the mechanical alterations observed in toast and baton sale, resulting in a diminution of texture and mouthfeel in both products or fortified treatments. These results align with Nikolaidis and Labuza's (1996) [29] observations. Conversely, the fortified toast and baton salé specimens exhibited diminished acceptability in comparison to the control sample with respect to texture characteristics, primarily attributable to the elevated fiber content, which resulted in a reduction in mouthfeel and texture. These results are consistently aligned with the findings reported in previous studies by Alemayhu *et al.* (2019) [3], Ali *et al.* (2012) [4], and Schwingshackl *et al.* (2015) [38]. The control was followed by treatments 1 and 2, which did not differ significantly from each other and used chia seeds or pumpkin seeds. Treatment 4 in both products (toast and baton sale) exhibited the lowest sensory attributes, which were the samples to which thyme was added. Conversely, treatment 3, which incorporated rosemary, exhibited superior sensory attributes in both products (toast and baton sale) when compared to T4. Overall, acceptance ratings for all formulations exceeded 71.5% for all sensory attributes. The acceptance levels of the control and treatment formulations ranged from 77.3 to 87.5% in the toast, indicating a 10% decrease in quality between the best and worst samples. For baton sale, the acceptance range was from 77.9 to 91.4%, indicating a 13% decrease in quality between the best and worst samples.

Conclusion

The primary objective of this research was to produce nutritious toast and baton sale with diverse health benefits, making it available to consumers as a healthy and safe option for everyone, both healthy and ill. Because it is healthy, it can be consumed by all ages. Ten percent of whole wheat flour was replaced with a blend of sesame, peanuts, chickpeas, coriander, chia seeds, pumpkin seeds, rosemary, and thyme to improve the nutritional and sensory properties of toast and baton sale. Incorporating such functional ingredients into the diet is a positive step toward improving nutrition.

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