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Evaluation of toast and baton sale enhanced by some nutritional ingredients

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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% and151.77%), (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: *toast, baton sale, nutritional ingredients, fortification, functional.*

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تقييم التوست والباتون ساليه المعزز ببعض المكونات الغذائية

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الملخص العربي

في مجال دراسات الأغذية، يتجاوز تقييم الأغذية المختلفة الخصائص الحسية مثل المذاق والملمس ليشمل قيمتها الغذائية وتأثيراتها على الصحة. تقدم هذه الدراسة طريقة جديدة لتطوير منتجات التوست والباتون ساليه من خلال دمج مكونات غذائية مختلفة ذات قيمة صحية وغذائية عالية عن طريق استبدال ١٠٪ من دقيق القمح الكامل بمزيج يحتوي على (السمسم والفول السوداني والحمص والكزبرة وبذور الشيا وبذور اليقطين وإكليل الجبل والزعتر) لتحسين جودة المنتج الغذائي وتوفير فوائد غذائية وصحية جديدة. تم تقييم تركيب المواد الخام المستخدمة لتقوية التوست والباتون ساليه. تم تحديد الخصائص الحسية والفيزيائية والكيميائية للتوست والباتون ساليه. أدى التدعيم إلى زيادة محتوى البروتين في التوست إلى ٤,٩٦٪ وحتى ١١,٣٩٪ في الباتون ساليه مقارنة بالعينة الضابطة المصنوعة من دقيق القمح الكامل وحده دون أي عوامل تدعيم. زاد محتوى الدهون والمعادن والألياف في االتوست والباتون ساليه بنسبة (١١٧,٥٪ و١٥١,٧٧٪) و (٢٤,٣٨٪ و٤١,١٧٪) و (١١,٥٦٪ و١١,٣١٪) على التوالي. انخفض محتوى الكربوهيدرات في التوست بنسبة ٦,٨٩٪، بينما انخفض في الباتون ساليه بنسبة ٧,٢٨٪. زادت السعرات الحرارية الناتجة عن التوست بنسبة ٢,٤٠٪ وبنسبة ٣,١٧٪ في الباتون ساليه. أما بالنسبة للمعادن مثل الكالسيوم والصوديوم والمغنيسيوم والبوتاسيوم والحديد والزنك والفوسفور والمنغنيز، فقد زاد محتواها في التوست والباتون ساليه بنسبة (١٥٣,٠٥ و٢٦٨,٠٩٪)، (١١٨,٥٨ و٣٦١,٨٩٪)، (١٢,٣٥ و٢٥,٤٣٪)، (١١,٥٣ و٣١,٢٩٪)، (٣٩,٨٤ و١٢٧,٧٢٪)، (٨,٢٤ و١٦,٨٢٪)، (٢,١٦ و٢,٢٢٪)، (-٢,٩٨ و٣,٠٢٪)، مقارنة بالمجموعة الضابطة. على الرغم من الخصائص الحسية الجيدة للتوست والباتون ساليه المدعمين بنسبة ١٠٪ من عوامل التقوية، تجاوز القبول العام للمجموعة الضابطة قبول التوست بنسبة ١٠,٢٪ والباتون ساليه بنسبة ١٣,٥٪. ومع ذلك، نوصي بزيادة استهلاك التوست والباتون ساليه المدعمين مقارنة بالمنتجات غير المدعمة لزيادة القيمة الغذائية والصحية وتلبية العديد من الاحتياجات الوظيفية لجسم الإنسان.

الكلمات المفتاحية: توست، باتون ساليه، مكونات غذائية، تقوية، وظيفية.

1. Introduction

Increased consumer awareness and interest in health, wellness, and nutrition have 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 and Rocha, 2007)**. 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)**, 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)**. 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 and Notarnicola et al. 2017)**. 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 and Crucean et al., 2023**). 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, increase 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 **(Aggarwal 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)**. 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**). 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**). 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 and Wrigley, 2016**). 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 and Oyedeji and Wu, 2023**). Proteins enhance nutritional value, while minerals and vitamins such as 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)**. Seeds or grains (such as flax, chia, and sesame seeds) can be added to provide healthy fats and omega-3s. Based on that, this study aimed to assess the effect of replacing 10% of whole wheat flour with a nutritious blend (sesame, peanuts, chickpeas, coriander, chia, pumpkin seeds, rosemary, and thyme) on the quality of toast and baton sale and to evaluate the feasibility of producing a sustainable, health-promoting baked product.

2. 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, were procured from Cairo's local markets.

3. Methods

Sample preparation

The control sample was made from whole grain wheat flour, and the fortified ingredients (sesame powder, peanut powder, chickpea powder, coriander powder, cumin powder, chia seed powder, pumpkin seed rosemary powder, and thyme powder) were substituted with 10% of the whole grain wheat flour for making studied toast and baton sale samples as showed in Table 1.

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

	Toast						Baton sale				
Ingredients(g)	**Control**	**1**	**2**	**3**	**4**	**Ingredients**	**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	-
Thyme powder		-	-	-	1.60	**Thyme 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)**. 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 **Emmanuel 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 method was employed to estimate sample volume, with 20 replicates performed for each sample using millet seeds. The methods suggested by **AOAC (2012)** 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 the **AOAC (2012)** 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 according to **AOAC (2012)**. 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. "The total energy value was calculated by multiplying fat by 9, protein and carbohydrates by 4, and dietary fiber by 2, according to standard energy conversion factors."

Mineral's analysis

Following the AOAC (2005) guidelines, the concentrations of calcium (Ca), magnesium (Mg), potassium (K), sodium (Na), zinc (Zn), iron (Fe), and manganese (Mn) were determined using atomic absorption spectroscopy. 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)**.

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)**. 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 El-Sheikh 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 of variance (ANOVA) test, the least significant difference (L.S.D) at 0.05, and Duncan's test. Analysis of variance (ANOVA) was applied for all statistical evaluations using Co-STATE software.

4. Results and discussion

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 non-significant change in ash in wheat flour (1.75%). 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)**, 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)**.

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}
Thyme 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 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)**. 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)**. The amount of calcium obtained from food sources does not exceed the recommended daily intake **(Aballay, 2012)**. Consequently, insufficient calcium intake can lead to osteoporosis and an elevated risk of fractures, particularly among postmenopausal women **(Zamudio et al., 2015)**. 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 ingredient 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 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}	3.5^{f}	140.0^{g}	430.0^{f}	4.00^{e}	2.90^{g}	400.0^{d}	4.00^{b}
Sesame seeds	700.0^{c}	7.5^{e}	350.0^{c}	450.0^{e}	14.00^{c}	6.50^{b}	600.0^{c}	2.50^{f}
Peanut	60.0^{e}	9.0^{d}	180.0^{f}	650.0^{d}	1.50^{f}	3.50^{f}	400.0^{d}	2.00^{g}
Chickpea flour	163.0^{d}	29.9^{b}	165.0^{g}	803.0^{c}	6.09^{d}	5.16^{c}	275.0^{e}	3.09^{d}
Coriander	709.0^{c}	34.0^{b}	265.0^{d}	1270.0^{b}	18.00^{b}	4.50^{d}	485.0^{d}	2.10^{g}
Cumin powder	920.0^{b}	170.0^{a}	367.0^{b}	1700.0^{a}	70.00^{a}	4.90^{c}	4.9^{h}	3.40^{c}
Chia seed powder	660.0^{c}	19.0^{c}	330.0^{c}	445.0^{e}	8.00^{c}	5.00^{c}	850.0^{b}	2.12^{g}
Pumpkin seeds	45.0^{e}	7.0^{e}	540.0^{a}	800.0^{c}	8.50^{c}	7.00^{a}	1125.0^{a}	4.30^{a}
Rosemary powder	650.0^{c}	25.0^{b}	155.0^{g}	300.0^{g}	8.00^{c}	1.70^{h}	70.0^{g}	2.80^{e}
Thyme powder	1350.0^{a}	30.0^{b}	240.0^{e}	750.0^{c}	12.00^{c}	2.50^{g}	120.0^{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 4 showed the chemical composition of baton bread and toast. Regarding toast and baton-sale, it should be noted that all treatments used resulted in increased protein, fat, ash and fiber content in toast and baton-sale compared to the control group to which no boosters were added. According to the protein, dietary fiber and ash content as an indicator of 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)**. Therefore, toast containing protein, dietary fiber and ash content as an indicator of mineral content 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 163.45% in sample B2 in baton-sale. 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 B4. 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 **(Ghoshal et al. 2016)**. It also improves constipation and prevents digestive problems **(Huang et al. 2015)**. 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)**. 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)**. 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 **(Wongsonsarim et al., 2001)**. All treatments also significantly reduced carbohydrate content compared to the control group, with the maximum carbohydrate reduction in treatment T2 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 2.71%, while in baton sale it reached 3.17% in sample B2.

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}
	Baton sale					
Blends	**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}

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 treatments 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)**, 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)**. A deficiency in zinc nutrients hinders bone development **(Payal et al., 2018)**. 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 5. Effect of different replacement ratios on 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^{e}	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^{e}	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

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 cm^3). 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 cm^3/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)**. With regard to density, all treatments applied resulted in a reduction in density compared to the control (0.49 g/cm^3). This may be attributable to the increase in volume observed in the treated samples compared to the control.

Table 6. Effect of different replacement ratios on Physical parameters of toast bread.

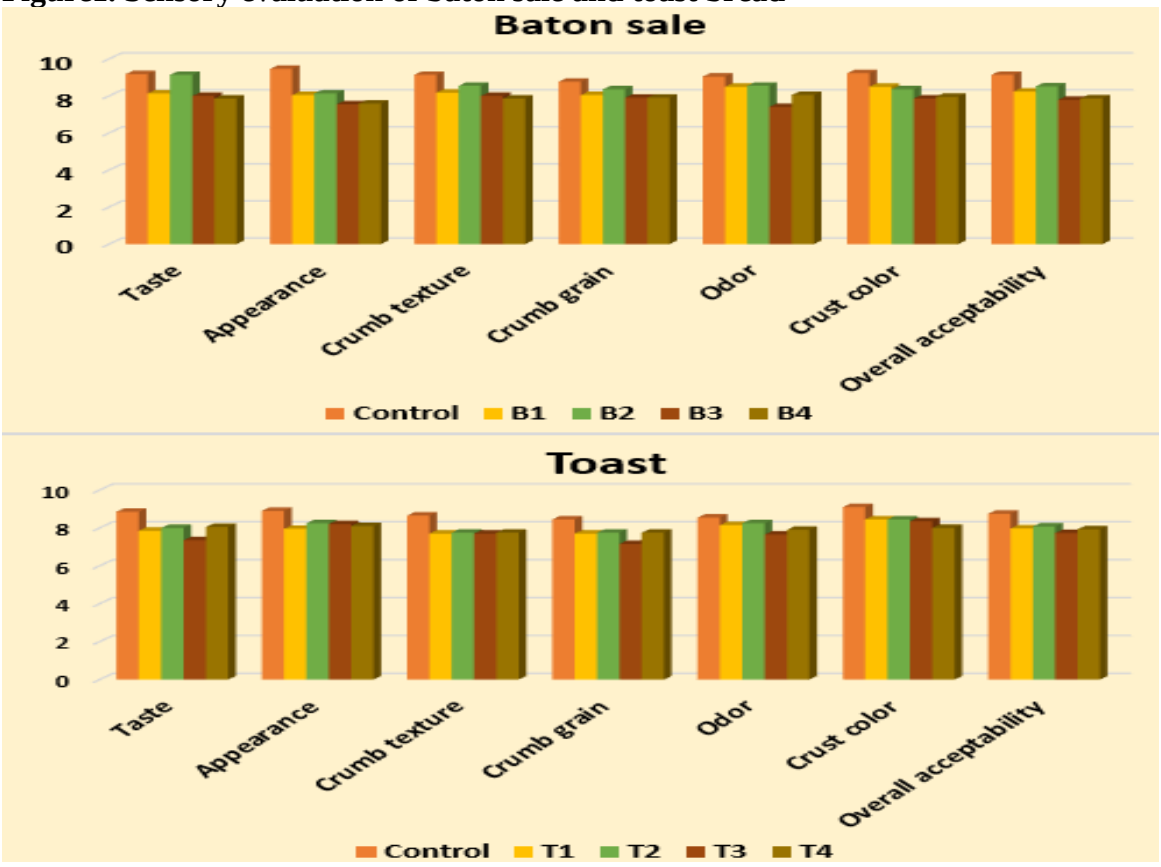
	Weight (g)	Volume (Cm^3)	Specific volume (cm^3/g)	Density (g/cm^3)
Control	339.15^b	693.00^d	2.04^d	0.49^a
T1	307.74^d	742.50^b	2.41^a	0.41^e
T2	352.16^a	836.00^a	2.37^b	0.42^d
T3	340.91^b	731.60^c	2.15^c	0.47^b
T4	321.46^c	692.00^d	2.15^c	0.46^c

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

As illustrated in **Figure 1, and Picture 1** 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)** 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)**, **Ali et al. (2012)**, and **Schwingshackl et al. (2015)**.

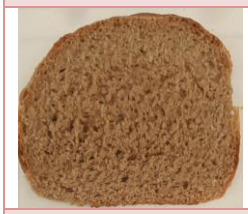
Figure1. Sensory evaluation of baton sale and toast bread



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.

Picture 1. The various shapes of baton sale and toast obtained from different treatments.

Baton sale				
				
Control	**B1**	**B2**	**B3**	**B4**
Toast after baking and before slicing				
				
Toast after slicing				
				
Control	**T1**	**T2**	**T3**	**T4**

5. Conclusion

In conclusion, this research successfully developed a complete nutritional value toast and baton sale fortified with sesame, peanuts, chickpeas, coriander, chia seeds, pumpkin seeds, rosemary, and thyme powder with diverse health benefits, making it available to consumers as a healthy and safe option for everyone, specifically designed to meet the essential nutrient

needs of children and all ages. A delicate balance has been achieved between high nutritional value, palatable taste, and the right texture, making the product a healthy and effective as a healthy snack for children to regain their energy after a long day at work. This achievement underscores the importance of investing in natural ingredients to produce innovative functional foods that contribute to promoting overall health and meeting the demands of modern lifestyles so, further research is imperative to get the most out of these functional foods with the lowest cost and lowest side effect of high dose.

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