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# Effect of Fenugreek and Seed Mix Addition on the Quality Characteristics of Bread

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***Abstract***
This study investigated how the addition of fenugreek powder and a mix of seeds affected the physicochemical and sensory characteristics of wheat flour bread. A mix of seeds composed of: sunflower, pumpkin, flax, sesame and chia were used to prepare the bread, added in a proportion of 5% of the flour mass. Fenugreek powder was added in a proportion of 5%, this concentration being established as the optimal variant following preliminary testing. The combined addition of fenugreek and seeds did not affect the elasticity of the dough but allowed for a uniform porous structure of the core after baking. The loaves thus obtained were analyzed both from a physicochemical point of view (moisture, acidity, porosity, NaCl content) and sensory (appearance, aroma, taste, texture). The results showed that the addition of fenugreek powder and seed mix influences the quality of bakery products, thus contributing to the improvement of nutritional value and the development of a functional bread with balanced sensory properties and potentially beneficial for health.
***Keywords*:** fenugreek, bread, seed mix, physicochemical analysis, sensory evaluation, functional foods.

## 1. Introduction

Bread making is an ancient practice that has evolved over time to reflect people's tastes, culinary traditions, and nutritional needs. Today, bread consumers are increasingly health-conscious, which drives innovative approaches in the baking industry, including the addition of beneficial and functionally diverse ingredients into the bread-making process. In this context, producing bread with the addition of fenugreek powder and a seed mix to the classic recipe enhances the nutritional value of the bread and provides multiple health benefits (Figure 1). By incorporating these high-value material resources, the bakery product aligns with consumer trends oriented towards functional and preventive foods. Fenugreek (*Trigonella foenum-graecum*) is a medicinal plant belonging to the Fabaceae family; it is an annual crop cultivated worldwide and is commonly known as fenugreek or "Greek hay" [1,2]. The seeds are used as a spice worldwide, while the leaves are consumed as leafy vegetables in the diet. *Trigonella foenum-graecum* seeds have a bitter taste and

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have long been recognized for their medicinal properties [1-4]. Fenugreek has a unique and rich caramel-like aroma [5,6]. The seeds, and consequently fenugreek powder, are rich in proteins, fiber, vitamins (such as C, A, B1, and B6, as well as folic acid), and essential minerals including iron, magnesium, and manganese. They are recognized for their ability to help regulate blood sugar levels and support digestive system health [7,8]. The seed mix used consists of pumpkin seed kernels (*Cucurbita maxima*), sunflower seed kernels (*Helianthus annuus*), sesame seeds (*Sesamum indicum*), flax seeds (*Linum usitatissimum*), and chia seeds (*Salvia hispanica*). Pumpkin is a good source of nutrients and phytochemicals, such as β-carotene, dietary fiber, vitamins, and minerals [9-12]. Sunflower seeds provide a significant contribution of essential nutrients that enhance the sensory properties of the product. They are rich in unsaturated fatty acids, such as linoleic acid (omega-6), which help reduce "bad" cholesterol (LDL) and maintain cardiovascular health, and plant proteins (approximately 20–25%), which are an important source of essential amino acids [13]. Sesame seeds are valued for their specific, slightly nutty taste, as well as for their remarkable nutritional contribution, being considered an ingredient with high functional value [14]. Flax seeds are recognized as a superfood due to their high content of essential fatty acids, fiber, and bioactive compounds with health-promoting effects [15,16]. Chia seeds have an exceptionally balanced composition: omega-3 fatty acids (alpha-linolenic acid – ALA), constituting up to 30% of their weight, making chia one of the richest plant sources of omega-3; proteins 16–20%, containing all essential amino acids, giving them a complete protein profile; fiber up to 34%, much of which is soluble, forming a mucilaginous gel upon contact with water; complex carbohydrates, released slowly, promoting a low glycemic index; vitamins: B1 (thiamine), B3 (niacin), and in smaller amounts B2, B6, and folic acid; minerals rich in calcium, phosphorus, magnesium, potassium, iron, and zinc; antioxidants, including caffeic acid, quercetin, and flavonoids, with anti-inflammatory properties [17,18]. Compared to other types of functional bread, bread with fenugreek and a seed mix offers a complete nutritional profile, being superior in terms of essential fat content, antioxidants, and minerals. Its pleasant, crunchy texture and nutty flavor make this variety appealing to a wide segment of consumers.

## 2. Materials and method

### *2.1. Raw materials and and auxiliary ingredients*

White wheat flour type 650 represented the main raw material used for bread production, along with potable water, bakery yeast (*Saccharomyces cerevisiae*), iodized salt and sunflower oil. The bread formulation was concluded with 1000 g of white wheat flour.

To enrich the nutritional and functional profile of the product, as auxiliary ingredients, 50 g of fenugreek powder (*Trigonella foenum-graecum*), representing 5% for the first sample and 100 g of fenugreek powder (*Trigonella foenum-graecum*), representing 10% for the second sample, were incorporated in the flour mass.

Additionally, 45 g of a mixed seed blend (pumpkin, sunflower, flax, and sesame) and 5 g of chia seeds were added, the total amount of 50 g of seeds providing additional dietary fiber and mucilaginous polysaccharides that support moisture retention and structural stability during baking.

The study included two experimental variants, differentiated by the concentration of fenugreek powder added:

- S5 – bread with 5% fenugreek addition (50 g per 1000 g flour);
- S10 – bread with 10% fenugreek addition (100 g per 1000 g flour).

The amount of seeds mixture was kept constant at 5% of the flour mass (50 g per 1000 g), with the following composition: 30% sunflower, 25% pumpkin, 20% flax, 20% sesame, and 5 g chia.

**Figure 1.** Bread with fenugreek powder and a seed mix

### *2.2. Bread samples preparation*

The dry ingredients (flour, fenugreek powder, and salt) were first mixed to ensure homogeneity. The activated yeast and water were then added, and the kneading process was initiated.

Kneading involved the mixing of basic and auxiliary materials, accompanied by a series of colloidal and physicochemical transformations, resulting in a dough mass with specific structural and rheological properties.

The dough was allowed to ferment at room temperature (~25°C) until its volume approximately doubled. After shaping, the samples were baked in an electric oven at 200°C for 35–40 minutes.

The dough with added fenugreek exhibited a characteristic yellowish hue, a mildly spicy aroma, and a subtle bitter taste, which was considered pleasant in combination with the crunchiness of the seeds. A slight adjustment in the amount of water (by 2–3%) was necessary, since the fibers and mucilage from the seeds and fenugreek absorb a greater quantity of liquid.

Fermentation was slightly slowed down due to the natural antifungal effect of certain compounds in fenugreek; this was compensated for by extending the proofing time by 10–15 minutes compared to the control sample. Following the tests, a bread was obtained that combines complex nutritional value (plant proteins, soluble fibers, unsaturated fatty acids, natural antioxidants), metabolic functionality (hypoglycemic, prebiotic, and antioxidant effects), and high sensory acceptability (pleasant taste, crisp exterior, elastic interior, and a distinct aromatic profile).

This formulation represents the basis for introducing an innovative variety in the category of functional artisanal or industrial breads, with potential adaptation to both traditional and mechanized production processes.

### *2.3. Sensory evaluation*

The sensory evaluation of the samples was carried out 12 hours after baking, using a panel of 10 people with experience in the analysis of bakery products. The quality of the samples was assessed based on a descriptive scale from 1 (very poor) to 5 (excellent), considering appearance, color, odor, taste, texture and overall acceptability.

### *2.4. Physicochemical determinations*

The physicochemical determinations were carried out 48 hours after baking and included:

- Humidity (%): by the gravimetric method (oven drying to constant mass)
- Acidity (°T): determined by titration with 0.1 N NaOH solution
- Porosity (%): calculated by the volumetric method
- Salt content (%): determined by the Mohr method (argentometric titration).

Each variant was analyzed in five repetitions, and the results were expressed as arithmetic mean ± standard deviation using Microsoft Excel formulas. The arithmetic mean (X) represents the average value of repeated measurements, while the standard deviation (sX) quantifies the degree of variation among them. The combined expression (X ± sX) reflects the standard error, which defines the expected range in which the true mean value lies, ensuring the reliability and reproducibility of the obtained data.

## 3. Results and discussion

The results of the sensory evaluation for bread samples with 5% (S5) and 10% (S10) fenugreek are presented in the figure 2. For S5, the most appreciated characteristics were the external and cross-sectional appearance, color and smell, all with very close average scores of 4.7 points. The consistency was slightly lower, 4.6 points, and the taste obtained 4.4 points, indicating a high overall acceptability. For S10, the appearance, color and odor were similar to S5 (values between 4.6–4.7 points), but the consistency decreased slightly to 4.4 points, due to the higher fiber content, and the taste was perceived as more bitter, thus obtaining a lower score of 4.0 points. In this case, increasing the amount of fenugreek significantly influences the sensory evaluation of taste and, to a lesser extent, texture, while the visual and olfactory attributes remain largely unchanged. These observations suggest that while a moderate addition of fenugreek (5%) maintains a good sensory quality, with a sweet and nutty taste, a higher addition (10%) may reduce the acceptability of the product due to the bitter taste. Based on the analysis of the sensory

evaluations, it can be concluded that the product exhibits a complex and well-balanced profile, characterized by enhanced nutritional attributes. The resulting bread distinguishes itself through its functional properties, while preserving the essential sensory qualities expected of a high-quality bakery product. Furthermore, it meets the established quality standards applicable to bread. Table 1. show the mean values and standard deviations (X ± sX) of the physicochemical characteristics of bread with fenugreek at two concentrations (5% and 10%) and with mixed seeds. A slight increase in moisture and acidity and a decrease in porosity can be observed with the higher fenugreek content, while the salt content remains nearly constant. Recent investigations of the researcers indicate that both the biochemical properties of fenugreek constituents and the technological parameters associated with incorporating seed mixtures exert a substantial influence on the physicochemical and sensory attributes of bread. Studies on fenugreek have demonstrated that its bioactive components have measurable effects on protein interactions, oxidative stability, and overall structural behavior in food matrices [6,7,8]. A key observation emerging from the literature is that the nutritional and functional value derived from adding fenugreek and mixed oilseeds to bread is strongly dependent on the physical form and processing state in which these ingredients are used [9-13].

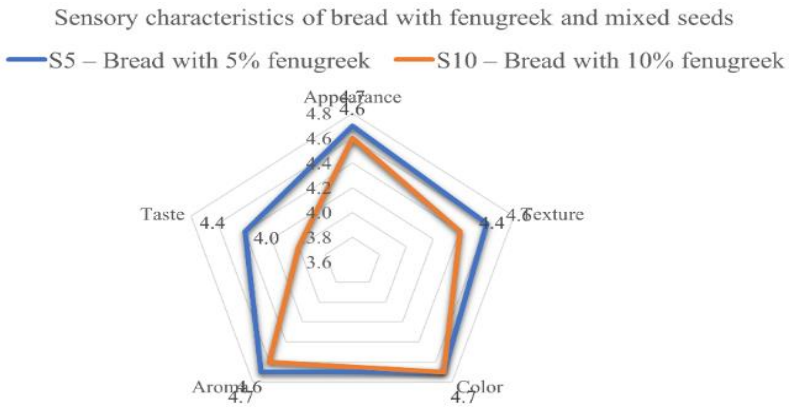


**Figure 2.** Sensory characteristics of bread with fenugreek:
S5 – bread with 5% fenugreek; S10 – bread with 10% fenugreek

**Table 1.** Mean values and standard deviations (X ± sX) of the physicochemical characteristics of bread with fenugreek (5% and 10%).

| Characteristic | S5 – 5% fenugreek | S10 – 10% fenugreek |
|---|---|---|
| Moisture (%) | 43.56 ± 0.74 | 44.23 ± 0.44 |
| Acidity (°T) | 3.04 ± 0.22 | 3.25 ± 0.15 |
| Porosity (%) | 79.11 ± 1.87 | 77.50 ± 1.50 |
| NaCl (%) | 0.84 ± 0.23 | 0.85 ± 0.10 |

## 4. Conclusion

The integration of functional ingredients, such as fenugreek powder and a mix of pumpkin, sunflower, sesame, flax and chia seeds, and advanced technologies in the bakery industry, play an important role in optimizing the production process, ensuring quality and creating successful innovative products. In today's modern trends, the bakery industry is frequently oriented towards functional and innovative products, motivated by people's increased concern for healthy eating. Fenugreek and seed mix bread is part of this trend and combines tradition with innovation. The added value of the product is generated by the integration of fenugreek powder and diversified oilseeds in the classic bread recipe. Sensory evaluation showed that the bread with 5% fenugreek and seed mix has a sweet taste, with nutty notes, being appreciated for its

texture and general acceptability, while the bread with 10% fenugreek and seed mix has a slightly bitter taste. Physicochemical analyses indicated that, with the increase in fenugreek content, the moisture and acidity increased slightly, the porosity decreased, and the salt content remained almost constant. These results confirm that the integration of fenugreek powder and seeds can be achieved without compromising the sensory and physicochemical quality of the bread. Fenugreek is used in various cultures as a natural remedy with potential health benefits, due to its rich content in soluble fiber and antioxidant compounds. In bakery, fenugreek increases the nutritional and functional value of the product, along with the oilseed mix which additionally brings a rich supply of essential fatty acids, fiber, vegetable proteins and minerals.

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