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Study of the Sensory Acceptance, Physical Properties and Microbial Analysis for Wheat Bread Enriched with Ginger and Black Pepper

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Abstract: This paper presents the studies on the enrichment of wheat bread with ginger and black pepper. The analyses of sensory acceptance, physical properties and microbial growth were explored. Four samples of enriched wheat bread were prepared which are non-enriched wheat bread (F1) as control, wheat bread enriched with black pepper only (F2), wheat bread enriched with ginger only (F3) and wheat bread enriched with ginger and black pepper (F4). The sensory analysis indicated that the F4 sample (4.400 ± 1.5128) has affected consumers' acceptance with the least sensorial acceptability. The colour mean values (L^*= 40.86 ± 1.0750, a* = 7.34 ± 0.1457 and b* = 20.70 ± 0.7770) and the highest texture mean value (543.947 ± 3.2745) of F4 sample respectively demonstrated that the ginger and black pepper influenced the enriched wheat bread colour and texture characteristics. The water activity (0.815 ± 0.0086) and moisture content (43.85 ± 0.5255) of the F4 sample considered low as compared to others formulated samples. In microbiological analysis, F4 exhibited the highest fungi count (3.7×10^7 cfu/mL) and kept increasing exceeded to 300 colonies than other samples at day 4 of storage. It can be inferred that adding ginger and black pepper to wheat bread reduced sensory acceptability, decreased water activity and moisture content, darkened the colour of the bread, and made the texture harder. However, the decrease in fungus colonies indicated that enriched wheat bread had a longer shelf life than other enriched wheat bread samples.

Keywords: Enriched wheat bread, Ginger, Black pepper, Physical properties, Sensory analysis, Microbial growth

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1. Introduction

Nowadays, many bakery industries in Malaysia began their production in small scale processors and expanded to medium-scale. As known, bread products have been listed as the most common needs for market requirements. Bread has been chosen as an excellent dietary source, especially with high fiber whole grain or wholemeal [1]. With the rising prevalence of diseases in Malaysia, such as high cholesterol, heart attacks, and obesity, consumers are becoming more conscientious about the foods they consume. Thus, wheat bread is one of the healthiest foods available.

Enrichment of wheat bread with ginger and black pepper is expected to provide many health benefits to the consumers not only for people in their diet but also postpartum mothers during their confinement period. According to Preedy et al., (2011) [2], the enriched wheat bread will improve the bread quality and nutritional value of the final product. In addition, the wheat bread enriched with ginger and black pepper is suitable to be consumed by vegetarian as it can be considered as plant-based food. Therefore, the effort to produce a ready-to-eat food product with high nutritional value such as wheat bread enriched with ginger and black pepper was studied.

Ginger and black pepper are spices that are commonly added to food as they are beneficial for human health. Ginger (Zingiber officinale), a member of the Zingiberaceae family, is a worldwide spice that is used especially in most Asian countries [3]. As ginger is founded in the Indo-Malayan region, it is now widely distributed across many countries and has always being used as a spice and considered as therapeutic plant [4]. It comprises over 400 different compounds in which the major elements in ginger rhizomes are 50–70% of carbohydrates, 3–8% of lipids, terpenes and phenolic compounds [5]. Due to its chemical characteristics, ginger is renowned for its healing properties such as halting coughs and has detoxification effects [6]. It also improves blood circulation by stimulating the heart muscle, thus enhancing the cellular metabolism and relieving the cramp and tension [7]. Furthermore, ginger plays an important role as a flavour enhancer as it contains essential oil and widely used as the main seasoning material in the diet [8].

Black pepper, scientifically known as Piper nigrum L. comes from the family of Piperaceae. Black pepper is used for various reasons, including human diets, as pharmaceutical items, preservatives and biocontrol agents [9]. This plant contains piperine that stimulate the digestive enzymes of the pancreas and intestines. It can also increase the secretion of biliary bile acid once orally administrated [10]. Furthermore, black pepper is rich in sources of potassium, iron, manganese and antioxidant enzyme which can help in controlling the heart rate and blood pressure, also producing red blood cells [11]. In addition, it is rich in vitamin B such as riboflavin, thiamine, niacin and zinc. With the function of improving food flavour, it is mostly used as a seasoning ingredient as well as in food preservation [12].

This work aimed to explore the physical properties, sensory acceptance and microbial growth of enriched wheat bread. The physical properties study was focused on the water activity, moisture content, colour measurement and texture analysis. The sensory evaluation was carried out by descriptive tests method. A descriptive test usually provides a detailed profile of the sensory attributes of a food product, as well as a qualitative measurement of the intensity of each attribute. Furthermore, the microbial analysis was determined by using the Total Plate Count (TPC) method. It is because, the deterioration of bread products normally causes by microbial spoilage. The interpretation results of growth of the bacteria can be calculated and recorded as total number of bacteria in colony forming units (cfu) value.

2. Materials and Methods

2.1 Materials

Whole wheat flour, yeast, butter, honey, salt, ginger powder, black pepper powder are materials that were used in this study. Several instruments included Mixer (HM 200 Khind, Malaysia), baking oven (XYF-1DAi The Baker, Malaysia), water activity meter (AL 182 Aqualab, USA), moisture analyzer (MX-50 A&D, Japan) TA-XT plus texture analyzer (Stable Micro System Ltd, Goldaming Surrey, UK) and colour flex (Miniscan EZ, Hunter Lab, USA) were utilised in this study.

2.2 Preparation of wheat bread enriched with ginger and black pepper

Dough and bread samples were prepared by using a sponge and dough method. The sponge was prepared by mixing 216 g whole wheat flour, 10 g yeast and 210 g water [13] for 8 min at min speed utilising a household mixer and the resulting sponge was placed into a proofer at a temperature of 30 ̊C for 1 h before adding it to the bread dough. After the resting period, the sponge was mixed with dough for 11 min at min speed by utilising the same mixer in the following order: 144 g whole wheat flour, 15 g butter, 40 g honey, 7 g salt [13]. Then the dough was kept for 10 min at room temperature (22 °C) before it was kneaded and left for rest for 20 min at room temperature.

Following that, the dough was fermented for 2 hrs at 30 °C and 70 % relative humidity in a proofer. The fermented dough was baked for 30-45 mins at 180°C. Following baking, bread samples were cooled for approximately 2 hrs at room temperature (22 °C). The baking process was performed in triplicate and the whole process was repeated by adding ginger and black pepper to the wheat bread dough according to the formulation in Table 1. Four samples of enriched wheat bread were prepared which are non-enriched wheat bread (F1), wheat bread enriched with black pepper only (F2), wheat bread enriched with ginger only (F3) and wheat bread enriched with ginger and black pepper (F4).

Table 1: Amount of ginger and black pepper added to the wheat bread dough according to the formulation

Samples/Formulation	Amount of ingredients	
	Ginger (g)	Black pepper (g)
F1	0	0
F2	0	5
F3	10	0
F4	10	5

2.3 Sensory analysis (descriptive test)

The sensory test was conducted by ten trained panellists who were recruited from UTHM Campus Pagoh (staff and students) and are regular wheat bread consumers. Two hours after baking, enriched wheat bread samples were mechanically sliced into 2 cm thick slices [14] and cooled to 19°C. The slices were then placed on disposable paper trays and labelled with three random digits. The colour, flavour, texture, odour and overall acceptance for enriched wheat bread samples were evaluated by the panellist.

2.4 Colour measurement

A slice of enriched wheat bread was cut from three different loaves of control samples and the colour of samples was evaluated and mean values are taken for comparison [14]. The colour of enriched wheat bread samples was measured using Colour flex and numerical values of L*, a* and b* were recorded. The steps were repeated for the remaining enriched wheat bread samples.

2.5 Water activity

The 5 g of enriched wheat bread sample was placed in a small container before being put in the water activity meter. The steps were repeated in triplicate and water activity values for each enriched wheat bread sample were recorded.

2.6 Moisture content

5 g of samples were placed into a moisture analyser at the temperature of 160 °C to test the moisture content in the sample. The steps were repeated in triplicate for each enriched wheat bread sample.

2.7 Texture analysis

The enriched wheat bread samples were sliced mechanically from the middle part of the loaf. The firmness of enriched wheat bread samples was carried out using a single-arm TA-XT Plus texture analyser. Readings were repeated in triplicate for each sample to obtain accurate data.

2.8 Microbiological analysis

Microbiological analysis was performed from day one until day four storage. Fungi counts were performed on the enriched wheat bread samples to determine the microbial load of the samples. 10 g of enriched wheat bread samples were made by mashing and mixing in 90 mL peptone water. Subsamples were diluted decimally until x10-6 and 0.1 mL aliquots were spread plated on potato dextrose agar (PDA) for the enumeration of fungi. The PDA plates were incubated at room temperature (28 ± 2°C) for 3–5 days. The colonies were then counted and expressed as colony forming units per millilitre (cfu/mL) of samples.

2.9 Statistical analysis

The results were expressed as means ± standard deviation to show variations in the various experimental. Differences were considered significant when $P<0.05$. All samples of enriched wheat bread were analysed in triplicates thus, the averages and standard deviation of the means were calculated using Microsoft Excel 2013 (Vista Edition, Microsoft Corporation, USA).

3. Results and Discussion

3.1 Sensory analysis

The sensory attributes, with their assessment scores by the panellist for a wheat bread enriched with ginger and black pepper samples, are shown in Table 2. The results revealed that the sensory qualities (colour, intensity, texture, odour and overall acceptance) of enriched wheat bread samples are changes with the additional amount of ginger and black pepper. In terms of enriched wheat bread colour, there were significant differences ($P<0.05$) between all enriched wheat bread formulations. The F1 sample has a lightness colour with a mean value is 2.675 ± 1.304. While F4 sample has the darkest colour with high mean value of 8.475 ± 2.244. This increasing colour mean value of F4 sample is due to the darkest colour. However, F2 and F3 samples indicate the mean value of 7.200 ± 1.882 and 5.388 ± 2.594, respectively. The colour mean value of F3 sample is higher than F2 sample due to additional black pepper proved that the black pepper affects the colour of the enriched wheat bread sample produced. This result is supported by Popov-Raljić et al. (2009) [15], where the colour of bread is high related to the ingredients used.

For the flavour of enriched wheat bread samples, highly show that there are significant differences ($P<0.05$) of flavour for enriched wheat bread formulation. The results show that the control sample of F1 sample becomes the most preferred by the panellist with the flavour mean value of 8.888 ± 1.764, while the F4 sample with a flavour mean value of 3.338 ± 2.051 is the least preferred flavour by the panellist. For F2 and F3 samples obtained flavour mean values of 8.325 ± 3.227 and 6.875 ± 2.704, respectively. This finding indicated that the ginger and black pepper strongly affected the essential taste, and flavour attributes of enriched wheat bread sample. According to Haniadka, et al. (2013) [16] and Hammouti, et al. (2019) [17], non-volatile compounds in ginger and black pepper (piperine) are responsible for the sharp, hot feeling in the mouth and hot burning pungent taste will contribute to unpleasant flavour. In short, additional ginger and black pepper increased the flavour of mean value and imparted a more pungent taste.

In term of texture, the enriched white bread showed no significant to the texture of enriched wheat bread samples, there are no significant differences (P > 0.05) between enriched wheat bread formulations. The F1 sample (control sample) has the softest texture with the texture mean value of 4.975 ± 2.732, followed by the F2 sample (6.800 ± 3.369) and F3 sample (6.250 ± 2.780). The sample of F4 has the highest texture mean value of 7.238 ± 3.453. The increasing of texture mean value directly indicates the increasing of hardness texture of enriched wheat bread sample. This observation proved that the additional amount of ginger and black pepper in the enriched wheat bread dough is responsible for changing the hardness texture of enriched wheat bread samples. Meanwhile, there is a significant difference (P<0.05) between enriched wheat bread formulation in terms of its odour. The data indicated that the F2 and F3 samples have odour mean values of 4.888 ± 2.784 and 8.113 ± 2.603, respectively. While the F1 sample as control has the lowest odour mean value of 2.975 ± 1.726. The more increasing mean value of odour indicates the enriched wheat bread sample has the strongest odour among the samples. The responsible characteristic of odour for enriched wheat bread is due to volatile oils compound that presents in ginger and black pepper. Different results of odour mean values are due to different percentages of volatile oils of ginger and black pepper. The volatile oils of ginger (shogaols and gingerols) have the highest percentage which is 1 % while the volatile oils of black pepper (piperine) are 0.4 % [18]. Since that, the F4 sample results in producing the strongest odour with a mean value is 8.600 ± 2.079.

The overall acceptance result showed that the F1 samples as control sample has the highest mean value (9.538 ± 1.772), followed with F2 sample (6.525 ± 2.771), F3 sample (5.788 ± 3.972) and F4 (4.400 ± 1.513). In terms of overall acceptance, there was a significant difference (P<0.05) between enriched wheat bread formulation. F4 sample is the least mean value of overall acceptance due to the darkness of colour, hardness of texture, strongest odour and unpleasant flavour obtained from the ginger and black pepper.

Table 2: Data of sensory analysis for enriched wheat bread formulation

Samples	Colour	Flavour	Texture	Odour	Overall acceptance
F1	2.675 ± 1.304	8.888 ± 1.764	4.975 ± 2.732	2.975 ± 1.726	9.538 ± 1.772
F2	7.200 ± 1.882	8.325 ± 3.227	6.800 ± 3.369	4.888 ± 2.784	6.525 ± 2.771
F3	5.388 ± 2.594	6.875 ± 2.704	6.250 ± 2.780	8.113 ± 2.603	5.788 ± 3.972
F4	8.475 ± 2.244	3.338 ± 2.051	7.238 ± 3.453	8.600 ± 2.079	4.400 ± 1.513

*Values are expressed as mean ± standard deviation

3.2 Colour measurement

Table 3 shows the mean values of L*, a* and b* for enriched wheat bread samples. F1 sample as a control sample has the highest L* mean value (48.04 ± 0.54) indicates a lighter colour. F2 sample has the darker colour with L* mean value is 42.74 ± 0.64, compared with the F3 sample with L* mean value is 42.97 ± 0.66. The F4 sample shows a slightly similar mean value of L^*(40.86 ± 1.08) with F2 and F3 samples. It proved that the black pepper will result in darker of the enriched wheat bread sample due to its black colour characteristic. The mixture of ginger and black pepper for enriching a wheat bread (F4 sample) result in a darker wheat bread colour due to the combination of the black and yellow colour of black pepper and ginger respectively.

The results of the mean value for a* and b* (Table 3) are also shown. Parameter of a* and b* value indicates the redness and yellowness of enriched wheat bread samples respectively. The a* and b* mean values for all enriched wheat bread have shown significant difference where F2 sample has a minimum mean value of a* (6.74 ± 0.41) and b* (19.31 ± 0.511), followed with F3 sample (a* = 7.63 ± 0.27 and b* = 21.53 ± 0.35) and F4 sample (a* = 7.34 ± 0.15 and b* = 20.70 ± 0.78). It shows that the addition of ginger and black pepper will decrease the mean value of a* and b* of enriched wheat bread. However, the F1 sample has the maximum mean value of a* (8.73 ± 0.32) and b* (23.76 ± 0.33) revealed the absence of ginger and black pepper.

Furthermore, the colour of enriched wheat bread samples not only influenced by the addition of ginger and black pepper but is also expected mostly influenced by the Maillard reaction as a result of cooking [19]. The Maillard reaction is a chemical reaction that occurs during the baking process between reducing sugars and amino acids. The extent to which these reactions occur is mainly determined by the physical mechanisms of heat and water transport during the baking process. Thus, the development of bread colour is influenced by dough recipes and processing conditions such as time, temperature, air velocity, relative humidity, and heat transfer rate [20].

Table 3: Data of colour measurement for enriched wheat bread formulation

Samples	L^*	a^*	b^*
F1	48.04 ± 0.54	8.73 ± 0.32	23.76 ± 0.33
F2	42.74 ± 0.64	6.74 ± 0.41	19.31 ± 0.51
F3	42.97 ± 0.66	7.63 ± 0.27	21.53 ± 0.35
F4	40.86 ± 1.01	7.34 ± 0.15	20.70 ± 0.77

*Values are expressed as mean ± standard deviation

3.3 Water activity

The water activity of food indicates the minimum amount of water available for microbial growth. Controlling water activity is critical for food chemical stability. Water activity has a significant effect on the physical properties of foods, such as texture and shelf life. The result of water activity for all enriched wheat bread samples during storage for 5 days was obtained. The water activity value of F1 (control sample) has the highest water activity value for 5 days. However, water activity for enriched wheat bread samples is observed lower water activity values than F1 samples. Between formulated enriched wheat bread samples, the F2 sample has the highest water activity and the F4 sample has the lowest water activity. This result performs a significant difference ($P<0.05$) between them, as it has increased in water activity. The increase in water activity might be due to the storage process. In this research, the enriched wheat bread samples were stored in zip-lock packaging where this condition would exhibit the growth of microorganisms such as fungi to the samples. Studied by Ijah et al. [21], the increase of water activity value of bread produced from wheat and potato flour after 6 days of storage is due to attack by the microorganism. Other than that, it is also due to the high rate of migration of water vapour from the storage environment into the packaging material (zip-lock packaging). Ackermann (1995) [22] mentioned that the permeation, migration and reactions between packaging components with food components will result in increasing of water activity in the food that makes the food lose its odours and flavours.

Table 4: Data of water activity for enriched wheat bread formulation

Samples	Water activity (%)				
	Day 1	Day 2	Day 3	Day 4	Day 5
F1	0.872 ± 0.004	0.873 ± 0.002	0.880 ± 0.004	0.881 ± 0.005	0.884 ± 0.002
F2	0.867 ± 0.002	0.869 ± 0.005	0.874 ± 0.001	0.874 ± 0.004	0.887 ± 0.003
F3	0.841 ± 0.005	0.845 ± 0.001	0.847 ± 0.004	0.855 ± 0.001	0.858 ± 0.004
F4	0.815 ± 0.009	0.818 ± 0.002	0.822 ± 0.003	0.835 ± 0.008	0.846 ± 0.006

*Values are expressed as mean ± standard deviation

3.4 Moisture content

Table 5 tabulates that the moisture content of enriched wheat bread samples has a significant difference ($P<0.05$) during storage of 5 days. The moisture content ranged from 43.85% ± 0.53 to 46.40% ± 0.51 (Table 5). The highest value was observed for F1 which is a control sample, while the lowest was found for the F4 sample. There were significant differences ($P<0.05$) for all enriched wheat bread formulations. This indicated that the addition of ginger and black pepper in the enriched wheat bread can cause decreasing the moisture content. Also, the different formulations of ginger and black pepper could be affected the decreasing moisture content in enriched wheat bread samples. This result was supported by Alakali, et al. (2009) [23]; reported that ginger powder absorbs more moisture in food. The absorption of moisture by ginger powder results in low moisture of the enriched wheat bread samples. It is indicated that the relatively low moisture content represents a longer shelf life of enriched wheat bread. After baking, a moisture gradient existed between the crust and the crumb, which tended to equilibrate during storage. During storage, a part of the moisture in enriched wheat bread migrated from the crust and crumb to the surrounding atmosphere at a rate determined by the mass transfer resistance at the bread-atmosphere interface. It proved the decreasing of moisture content in bread during storage. This observation was supported by Muhammad et al., (2014) [24], who reported that there is a decrease in the moisture of freshly baked bread where the bread moisture decreased sharply with time. The crumb of freshly baked bread contained about 47% moisture. However, during 2 hours of cooling, the moisture dropped to 41%.

Table 5: Moisture content for control and enriched wheat bread formulation

Samples	Moisture content (%)				
	Day 1	Day 2	Day 3	Day 4	Day 5
F1	46.40 ± 0.51	45.89 ± 0.07	45.47 ± 0.30	44.92 ± 0.15	43.06 ± 0.78
F2	45.96 ± 0.29	45.20 ± 0.16	44.64 ± 0.44	44.45 ± 0.23	43.45 ± 0.38
F3	44.52 ± 0.24	45.01 ± 0.41	43.10 ± 0.28	42.87 ± 0.60	42.38 ± 0.56
F4	43.85 ± 0.53	43.57 ± 0.29	42.87 ± 0.04	42.75 ± 0.10	41.38 ± 1.33

*Values are expressed as mean ± standard deviation

3.5 Texture analysis

Firmness is defined as the maximum force obtained during compression. In terms of bread firmness, it can be defined as a loss of softness in the breadcrumb [25]. The mean value force of firmness for formulated enriched wheat bread samples was shown in Table 6. The F4 sample has the highest firmness compared to other enriched wheat samples. It shows that the increase of firmness may be due to the amount of ginger and black pepper that was added to the enriched wheat bread dough during preparation. Furthermore, it can be confirmed that the firmness mean value of F2 sample is higher compared to F3 sample. This result can be supported by Balestra, et al. (2011) [14] where an increasing amount of ginger powder added to the bread resulted in the hard texture of the bread and study by [26], whereas the increasing amount of addition of raw mango peel powder will increase the firmness of the bread.

In terms of the storage period, result shows that there is an increasing firmness for the bread sample. As expected, the firmness values of enriched wheat bread samples increased, with increasing time storage. This could be due to significant changes in all components of bread that contribute to the bread's quality deterioration, referred to as bread staling [27]. Bread staling is a highly complex process that occurs as a result of several changes in the starch structure of the bread, including amylopectin retro gradation, polymer rearrangement within the amorphous region, moisture loss, and water distribution between the amorphous and crystalline zones [28]. In this study, migration of moisture from the wheat bread crumb samples to the surrounding has resulted in the increasing firmness of the wheat bread samples. The greater the migration of moisture from the crumb to the surrounding, the faster the loss of moisture in the wheat bread samples.

Table 5: Data force of firmness for enriched wheat bread formulation obtained from texture analysis

Samples	Force (g)				
	Day 1	Day 2	Day 3	Day 4	Day 5
F1	323.504 ± 1.717	509.327 ± 2.967	729.041 ± 4.735	1142.662 ± 2.542	1251.856 ± 1.924
F2	460.771 ± 2.894	492.139 ± 2.922	559.509 ± 3.660	922.022 ± 2.346	1013.664 ± 4.347
F3	408.130 ± 2.669	438.815 ± 1.561	507.344 ± 2.226	784.752 ± 4.938	893.661 ± 2.507
F4	543.947 ± 3.274	726.116 ± 4.401	1095.773 ± 4.036	1354.553 ± 3.328	1969.123 ± 1.884

*Values are expressed as mean ± standard deviation

3.6 Microbiological analysis

The microbiology test's results shown that the number of fungi present in the colony forming unit per millilitre (cfu/mL) value in different formulations of enriched wheat bread samples (Table 7). On day 1, no growth of fungi in all samples. On day 2, the fungi were initially grown in the enriched wheat bread samples except for F1 as a control sample. However, the fungi started to grow in F1 on day 3 with the fungi count is 5.6×10^6 cfu/mL. Meanwhile, the F4 sample has the highest fungi count which is 3.7×10^7 cfu/mL compared to F2 and F3 samples, where the fungi count of samples are 2.2×10^6 cfu/mL and 8.3×10^5 cfu/mL, respectively. As the growth of fungi on the enriched wheat bread samples keeps increasing, the number of fungi on the F4 sample cannot be count as it grows to exceed 300 colonies on day 4.

The increasing number of fungi on the enriched wheat bread samples possibly due to the abundance of moisture in the enriched wheat bread which provides for a favourable condition for the growth of the fungi [22]. The higher moisture content could lead to an increasing number of fungi growth on the enriched wheat bread samples. Fungi have the potential to contaminate the enriched wheat bread samples when the number of colonies exceeds 300 colonies. Fungi counts were higher probably not only because of its moisture content but may also due to the addition of ingredients used, processing of the wheat bread, handling and storage of the sample.

Table 7: Data of fungi count in colony forming unit per millilitre (cfu/mL) on enriched wheat bread formulation

Samples	Colony-forming unit per millilitre (cfu/mL)			
	Day 1	Day 2	Day 3	Day 4
F1	-	-	5.6×10^{6}	1.9×10^{7}
F2	-	8.3×10^{5}	3.0×10^{6}	8.8×10^{6}
F3	-	2.2×10^{6}	1.1×10^{8}	1.7×10^{9}
F4	-	3.7×10^{7}	4.8×10^{7}	< 300

*Values are expressed as mean of colony forming unit per millilitre (cfu/mL) of fungi

4. Conclusion

This work addressed the enrichment of wheat bread with ginger and black pepper resulted in effect the sensory acceptance, physical properties including colour measurement, texture performance, water activity and moisture content analysis. Wheat bread enriched with ginger and black pepper (F4) showed the least sensorial acceptability by the panellist. The physical properties of wheat bread enriched with ginger and black pepper showed the lowest water activity and moisture content mean values, darker in colour and hardness texture characteristics compared to other enriched wheat bread samples. The microbiological analysis on wheat bread enriched with ginger and black pepper revealed more than 300 colonies of fungi at 4 days of storage. Nevertheless, although this enriched wheat bread gives the least acceptability by panellists and minimum physical evaluation performances, this formulation possibly can be altered by further studying the optimization of ginger and black pepper ratio amount in the preparation of enriched wheat bread. Also, the acceptability of this enriched wheat bread would only be possible with a lot of awareness creation about the health potentials. Therefore, this work could be emphasised the possibility of enriching wheat bread with ginger and black pepper highlighted.

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