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The effect Addition of Black Cumin Oil As Antifungals on Quality of Cake products Tabarih Hamid Modathir Hamid and Hassan Khojali Awad Elseed Abush Department of Food Science and Technology Faculty of Agriculture.

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Abstract*: Effect of addition black cumin oil on the chemical (water, ash, fat, protein, carbohydrate, peroxide value) characteristics and sensory (flavour, taste, texture, overall) characteristics of cake product were investigated. The oil of cake was substituted added with 0% (A), 10% (B), 5% (C) and 2. 5% (D) black cumin oil. The result showed that highest moisture content (19.5%) in sample B was decreased during storage and protein content was found (15.5%) in sample D, while acidity and peroxide value were affected by the addition of cumin oil and storage period then record (0.6%) and (4.0%) respectively in all samples of cake. The sensory characteristics, panelist gave the high score for cake in sample B which was added 0.05% nigella sativa oil, for appearance (4.3%), taste (4.0), texture (4.2), flavour (4.3) and overall acceptability (4.3). The study recommended the use of cumin oil by 10% of other oils in the cake industry, as it helped to preserve the product and the best sensory acceptance*.

Keyword: Effect, Black Cumin Antifungal, Quality Cake products

Introduction: Cake is a popular bakery product consumed for its palatable taste. The main ingredients used in cake production include wheat flour, margarine, eggs, sugar and baking powder. Among the different ingredients used in the production of cake, wheat flour constitutes a major component. Wheat flour is critical in baking products due to its gluten content. Gluten is the functional protein in wheat flour required for the quality characteristics of bakery products since the protein impacts on cell formation, crumb and crust structure, volume, porosity and other high quality attributes such as tenderness, shelf life and tolerance to stalling (Jaganathan, 2016).

Black cumin (Nigella sativa L.) belongs to Ranunculaceae family and is native to some parts of the Mediterranean region. It is known as "Corekotu" in Turkish. Its seeds are not related to cumin or caraway, both of which belong to Apiaceae family. It grows in the Mediterranean countries to a maximum height of about 60cm and is cultivated in Turkey (Babayan et al., 1978; Başoğlu & Bayrak 1984; Türker 1996; Ramadan & Morsel 2002; Matthaus and Ozcan, 2011).

Black cumin seeds are used as spice in bakery products and other food applications. Also, its oil is used as edible oil (Aıtzetmuller et al., 1997). Oilseeds are important sources of oils being of nutritional, industrial and pharmaceutical importance. Non-conventional oilseeds are under consideration because their constituents have unique chemical properties and may augment the supply of edible oils (Cherry and Kramer 1989; Ramadan and Morsel 2002; Matthaus and Ozcan, 2011).

The seed of Nigella sativa (N. sativa) has been used in different civilization around the world for centuries to treat various animal and human ailments. So far, numerous studies demonstrated the seed of Nigella sativa and its main active constituent, thymoquinone, to be medicinally very effective against various illnesses including different chronic illness: neurological and mental illness, cardiovascular disorders, cancer, diabetes, inflammatory conditions, and infertility as well as various infectious diseases due to bacterial, fungal, parasitic, and viral infections (Yimer et al., 2019).

The black seed oil is popularly used in certain cases of chronic cough and as diuretic or carminative agents and bronchial asthma (Zawahry 1963; Baytop 1984). In consideration of the potential utilisation, detailed knowledge of the composition of Nigella sativa seed oil is of major importance. Little infor-mation is known concerning the exact composition of N.sativa seed oils (Başoğlu and Bayrak 1984; Ustün et al., 1990).
Justification: Nigella sativa essential oil showed complete inhibition zones against different Gram-negative and Gram-positive bacteria including Penicillium citrinum Bacillus cereus, Bacillus subtilis, Staphylococcus aureus and Pseudomonas aeruginosa (Mohamed et al., 2015).
Study problem: Cake is rich in nutrients, so it is a good medium for the growth of microbes and fungi, especially with poor handling and poor storage of such products. Objectives: Was to study the effect of addition of black cumin oil on the chemical (water, ash, fat, protein, carbohydrate, peroxide value) characteristics and sensory (flavour, taste, texture, overall) characteristics of cake product were investigated.
Materials and methods
Materials: The materials used in this study were: Cake flour, vegetable oils, Baking powder, Egg, sugar, vanillin flavor, Salt and

Milk were obtained from local market. Black cumin oil: was purchased from the Perfumery stores.

Methods

Cake Standard formula:

item	percentage				
Flour	750g				
Milk	200g				
Sugar powder	200g				
Oils	200ml	0ml	20ml	10ml	5ml cumin oil
Egg	4				
Baking powder	10g				
Salt	2g				
Vanillin	10ml				
Water	Variable				

Preparation of composite flour blends: The first steps, all ingredients mentioned above were weighed and the second step, 4 eggs were whipped with sugar till change into white colour and expand. Then, first step and second step was mixed and was added with 300g wheat flour, 200g sugar powder, 150ml milk, 1 g vanili, 1 g salt and nigella sativa oil (0%, 10%, 5% and 2. 5%). Then, brownies dough was poured on a baking sheet, and then was steamed for 45 minutes.

Chemical analyses

Moisture content: Moisture determination was conducted using the AOAC method (2003).

Peroxide value: Peroxide value (PV) of the oil was determined according to the AOAC method (2003).

Protein Content: Nitrogen was determined according to AACC method (2000) using combustion nitrogen analysis (CNA) protein analyzer (Flash EA 1112 Series, Thermo Finnigan).

Microbial Parameters: Total viable count, Mould and yeast enumeration by method as by (Beveridge, 2001).

Sensory evaluation: Ten trained panelists from the Department of Food Science Technology, AL-Zaeim AL-Azhari University, were chosen to judge on the quality of Beta vulgaris bulb ice cream in term of, appearance, flavour, texture and overall acceptability (Appendix 1).The sensory evaluation of ice cream was evaluated by scoring procedure described by (Ihekoryne and Ngoddy 1985).

Statistical analysis: The statistical analysis was performed using SPSS (2008). Data generated were subjected to SAS version 9.2 issued in 2014 by Microsoft Corporation, and then means were separated using DMRT as reported by Montgomery (2001).

Results and discussion

Chemical Composition of cake products

The results of moisture, crude protein, peroxide value, of cake products were illustrated in Table 1.

Moisture Content: As shown in Table 1and figure 1, showed the mean value of moisture content was significantly affected by addition black cumin oil in cake product ($P \leq 0.05$). The highest moisture content of cake products 19.5% was the highest in sample B, the lowest showed in control samples 12.5%. While the others sample ranked intermediate. Also the storage period showed significantly affected on moisture content of cake products.

The result showed less than Ligarnasari *et al*., (2018) who studies physical, chemical and sensory properties of brownies substituted with sweet potato flour (Ipomoea batatas L.) with addition of black cumin oil (*Nigella sativa L*.) and found the best formula of substituted brownies which was added 0.05% of nigella sativa oil had 24.89% water content

Amalia, (2011) states that high water content in the material will cause the texture of the product to become softer. Also Ketaren, (1986) states that, the higher the black cumin oil content, the higher the content of the water

Protein Content: Results in Table 1 and figure 2, illustrated the protein of cake products samples 11.7% in sample D control samples and lowest showed 9.5% in control samples, while the others sample ranked intermediate. The mean value of protein content was significantly affected by addition black cumin oil in cake product ($P \leq 0.05$). Also the storage period showed non-significantly affected on protein content of cake products.

Table (1) the effect of levels of black cumin oil and storage on chemicals properties of cake products

Test	Storage	A(control)	B	C	D
Moisture*	Zero Time	12.5±0.81^{f}	19.5±0.81^{a}	16±0.81^{c}	15.5±0.81^{d}
	After 10 days	12±0.81^{g}	16.7±0.81^{b}	14.9±0.81^{e}	15.5±0.81^{d}
Protein*	Zero Time	9.5±0.85^{e}	10±0.85^{cd}	10.5±0.85^{b}	11.7±0.85^{a}
	After 10 days	10.5±0.85^{b}	10.1±0.85^{c}	10.5±0.85^{b}	11.7±0.85^{a}
Acid**	Zero Time	0.6±0.11^{ab}	0.6±0.11 ^{ab}	0.6±0.11 ^{ab}	0.6±0.11 ^{ab}
	After 10 days	0.7±0.11^{a}	0.7±0.11^{a}	0.7±0.11^{a}	0.7±0.11^{a}
Peroxide**	Zero Time	4±1.5^{b}	4±1.5 ^{b}	4±1.5 ^{b}	4±1.5 ^{b}
	After 10 days	16±1.5^{a}	16±1.5 ^{a}	16±1.5 ^{a}	16±1.5 ^{a}

*Mean Values ± SE Within the rows & columns having different superscripts letter are significantly different (P≤0.05).
** Mean Values ± SE Within the rows & columns having different superscripts letter are not significantly different (P≥0.05).

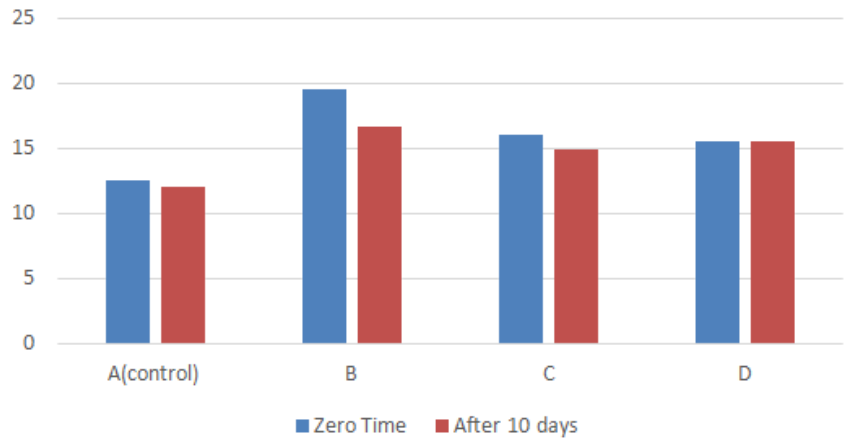

Figure (1) Moisture content

The result showed less than Ligarnasari *et al.*, (2018) who studies physical, chemical and sensory properties of brownies substituted with sweet potato flour (Ipomoea batatas L.) with addition of black cumin oil (Nigella sativa L.) and found the best formula of substituted brownies which was added 0.05% of nigella sativa oil had 37.79% protein content. Darmono, (1999) stated that the higher the protein content the higher the water binding capacity. Along with the increasing amount of protein as the cumin oil increases, the number of hydrophilic groups will also be higher.
The higher the hydrophilic group, the water absorption capacity will increase. The steaming process also has a considerable effect. Fellow, (1988) declared that steamed material will give the material the opportunity to absorb water vapour, resulting in an increase in the water content of the material. The increased protein content is caused by the content of 208 mg / g of protein in black cumin oil based on (Kamal and Huat, 2013).
Acidity: As shown in Table 1, Black cumin seed oils had a non-significant effect on the acidity of the cake products were record (0.6%) in all samples. However, the acidity of cake samples was increased significant during storage ($P < 0.01$) were found (0.7%) in all samples.

Peroxide value: As shown in Table 1, Black cumin seed oils had a non-significant effect on the peroxide value of the cake products were record (4.0%) in all samples. However, the storage was positive significant effect on PV of cake samples ($P < 0.01$).
The oxidative state of any vegetable oil can be evaluated from the combined analysis of its PV, and its specific absorption at 232 (K_{232}) and 270 nm (K_{270}) which indicates the presence of primary and secondary oxidation products, respectively. Peroxide values

above 10 have been reported for Nigella seed oil (Bourgou *et al*., 2010, Ali *et al*., 2012) suggesting its high sensitivity toward oxidation. Interestingly, whereas solvent-extracted Nigella seed oil from Morocco also presented a high PV (11.4 $MeqO_2$/kg), cold press-extracted Nigella seed oil PV was only 3.4 $MeqO_2$/kg, a value even lower than that was reported for the oil from Pakistan (Sultan *et al*., 2009).

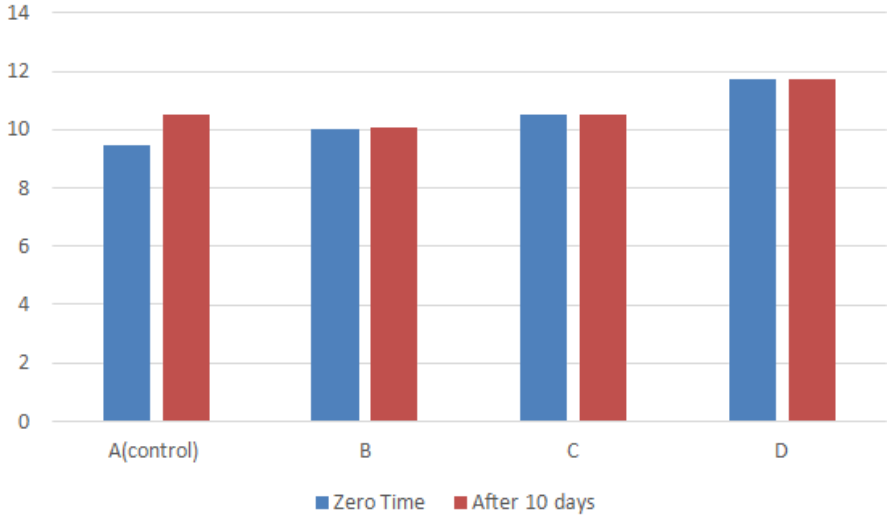

Figure (2) Protein content

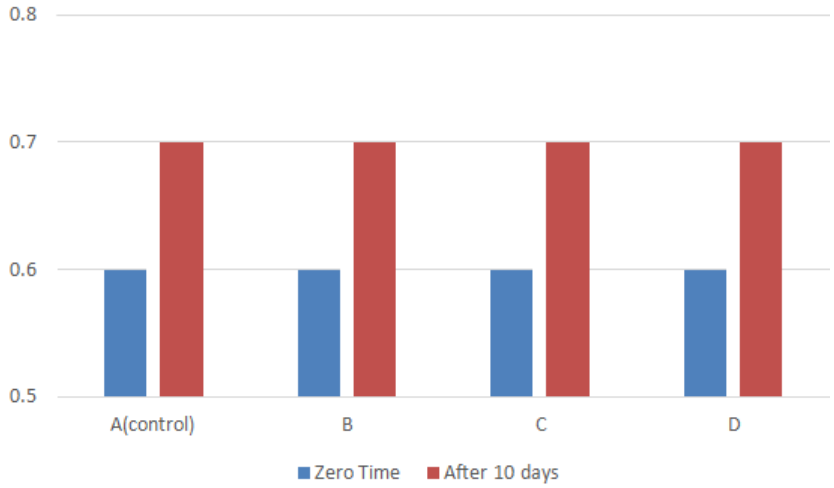

Figure (3) Titratable acidity

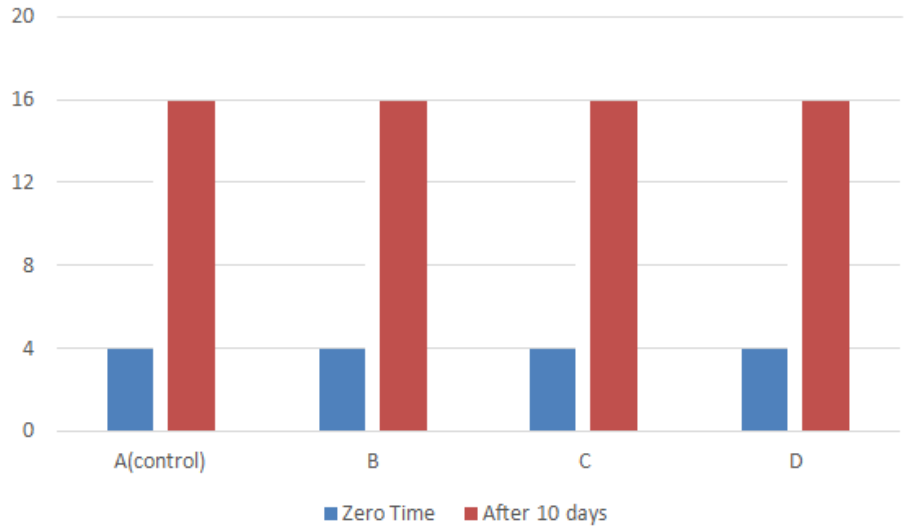

Figure (4) Peroxide value

Microbial analysis of cake products: The result found that, the of total variable count and fungi on cake products have shown that the concentration of essential oils achieve a significant antibacterial and fungi in all samples expect the control sample (with zero black cumin oils) was showed positive of total variable count and fungi in (table 2).

The main compounds included *p*-cymene, thymoquinone, *α*-thujene, longifolene, *β*- pinene, *α*-pinene and carvacrol. *Nigella sativa* essential oil exhibited different biological activities including antifungal, antibacterial and antioxidant potentials. *Nigella sativa* essential oil showed complete inhibition zones against different Gram-negative and Gram-positive bacteria including *Penicillium citrinum Bacillus cereus, Bacillus subtilis, Staphylococcus aureus* and *Pseudomonas aeruginosa* (Mohamed *et al*., 2015).

Investigations on meat products, fish, milk, dairy products, vegetables, fruit and cooked rice have shown that the concentration of essential oils needed to achieve a significant antibacterial impact is around 20 µL/g in foods and around 10 µL/mL in solutions for washing fruit and vegetables (Burt, 2004).

Nigella sativa essential oil showed complete zone inhibition against *Bacillus cereus, Bacillus subtilis, Staphylococcus aureus* and *Pseudomonas aeruginosa* at 2000 and 3000 ppm. The oil was found to be a complete zone inhibitor against *Bacillus subtilis* and *Staphylococcus aureus* at 1000 ppm. *Nigella sativa* essential oil gave antibacterial activities comparable to some standard antibiotics such as ampicillin and cloxacillin (Singh *et al*., 2005).

The antifungal activities for *Nigella sativa* volatile oil obtained by the food poison and inverted petriplate techniques. The essential oil revealed good zones of inhibition against *Aspergillus flavus, Fusarium graminearum, Fusarium monoliforme* and *Penicillium viridicatum* at different doses. In addition, the essential oil showed complete growth inhibition against *Penicillium citrinum* at 6 µL (Singh *et al*., 2005).

Nigella sativa essential oil exhibited also strong antifungal activity against *Aspergillus* species and it was found to be effective for Fusarium graminearum. For other fungi, essential oil exerted moderate to good zones of inhibition (Singh et al., 2005). The higher the volatility of the aroma components of an essential oil will leads to a higher vapor concentration in the surrounding air space. This might be responsible for the increase in antimicrobial activity with increase in dose concentration.

Most of the antimicrobial activity in essential oils derived from spices and culinary herbs is believed to derive from phenolic compounds. Nigella sativa essential oil contains good amounts of phenolic compounds (i.e., p-cymene, thymol and carvacrol) which might be the reason of the antimicrobial potential of Nigella sativa essential oil. The strength of inhibition and the spectrum of antimicrobial activity of Nigella sativa essential oil suggest that interactions between individual components led to the overall activity (Singh et al., 2005).

Khosravi et al., (2011) evaluated the effects of Nigella sativa essential oil on growth and aflatoxins production by A. parasiticus. Determination of aflatoxins (AFB1, AFB2, AFG1, and AFG2) was performed by immunoaffinity column extraction using RP-HPLC. In broth microdilution method, Nigella sativa oil exhibited strong activity (MIC90: 2.75; MFC: 6.25 mg/mL) against A. parasiticus. The study suggested that Nigella sativa oil might be used as natural inhibitors in foods at low levels to protect food from fungal and toxin contaminations by A. parasiticus. Viuda-Marto et al., (2011) determined the effectiveness of the Egyptian Nigella sativa essentials oil on the inhibition of the growth of some indicators of spoilage bacteria strains. They selected three bacterial spices (Listeria, Pseudomonas and Serratia) commonly associated with refrigerated foods, eggs, meat, milk, poultry, seafoods and vegetables. Nigella sativa oil exhibited high percentage of inhibition of DPPH radical (95.89 %) and high FRAC values (3.33 mmol/L Trolox). Essential oil of Nigella sativa showed also inhibitory effects on Listeria innocua.

Mahgoub et al., (2013) studied the impact of adding Nigella sativa oil at levels of 0.1 and 0.2 % (w/w) to Domiati cheese

supplemented with probiotic cultures on the inhibition of food-borne pathogens (Staphylococcus aureus, Escherichia coli, Listeria monocytogenes and Salmonella enteritidis) inoculated in cheese during storage. Nigella sativa oil showed antimicrobial effect wherein the concentration of

0.2 % oil had the most effective antimicrobial potential on pathogens when compared to the control. Storage life of oil-supplemented chesses was extended under refrigerated conditions with low microbial loads. In addition, oil-supplemented Domiati chesses had also improved physicochemical and sensory properties

Table (2) the effect of levels of black cumin oil and storage on microbial analysis of cake products

Attribute/sample	Time	A	B	C	D
Total Count Bacteria	**Zero time**	positive	Negative	Negative	Negative
	10 days	positive	Negative	Negative	Negative
Mold and yeast	**Zero time**	positive	Negative	Negative	Negative
	10 days	positive	Negative	Negative	Negative

Sensory evaluation of cake product: As shown in Table 3, Black cumin seed oils had a significant effect on sensory evaluation of the cake products were record (4.3) in appearance, taste (4.0), texture (4.2), flavour (4.3) overall acceptability (4.3) in samples B. However, the storage was positive significant effect on sensory evaluation of cake samples ($P < 0.01$).

Others similar study showed the highest scores for cake substituted sweet potato flour colour value was found for 0.05% addition of black cumin oil. The corresponding value was 4.05 (Ligarnasari *et al.*, 2017).

The highest scores for brownies substituted sweet potato flour flavour value was found for brownies substituted sweet potato flour with 0.05% addition of black cumin oil (Ligarnasari et al., 2017).

The specific flavour of brownies substituted sweet potato flour due to the volatile component from black cumin oil, one of volatile component was tymnoquinone which can cause distinctive sting flavor (Nickavar et al., 2003).

The highest scores for taste value was 0.05% addition of black cumin oil. The specific taste of brownies in this study was bitter (Ligarnasari et al.,2017). Goerlich reported that bitter taste due to nigellin was contained on the black cumin oil (Melapa et al., 2015).

Ligarnasari et al., (2017) found the highest panelist acceptance of brownies texture was found for 0.05% addition of black cumin oil. The texture of brownies was affected by the steamed cooking process and unsaturated fatty acid on the black cumin oil.

In general, these results showed the good acceptance of the brownies (table 2), the brownies substituted sweet potato flour which was added 0.05% black cumin oil had the highest number for color, taste, flavor, texture, and overall acceptance than that of the other of formula brownies. The brownies substituted sweet potato flour was added 0.25% black cumin oil had the lowest score for overall acceptance. The highest panelist acceptance for an overall score on brownies substituted sweet potato flour with was added 0.05% black cumin oil.

Table (3) the effect of levels of black cumin oil and storage on sensory properties of cake products

	Storage period	A	B	C	D
Appearance*	Zero Time	1.9 ± 0.2^{g}	4.3 ± 0.2^{b}	3.9 ± 0.2^{c}	3.2 ± 0.2^{e}
	After 10Days	1.7 ± 0.2^{h}	4.7 ± 0.2^{a}	3.4 ± 0.2^{d}	2.6 ± 0.2^{f}
Taste*	Zero Time	2.1 ± 0.22^{e}	4 ± 0.22^{b}	3.4 ± 0.22^{c}	2.9 ± 0.22^{d}
	After 10Days	1.8 ± 0.22^{f}	4.3 ± 0.22^{a}	3.4 ± 0.22^{c}	2.1 ± 0.22^{e}
Texture*	Zero Time	2.2 ± 0.2^{g}	4.2 ± 0.2^{b}	4 ± 0.2^{bc}	3.3 ± 0.2^{e}
	After 10Days	2.2 ± 0.2^{g}	4.5 ± 0.2^{a}	3.9 ± 0.2^{cd}	2.5 ± 0.2^{f}
Flavour*	Zero Time	1.9 ± 0.19^{f}	4.3 ± 0.19^{a}	3.4 ± 0.19^{c}	3.2 ± 0.19^{d}
	After 10Days	1.4 ± 0.19^{g}	4.3 ± 0.19^{a}	3.7 ± 0.19^{b}	2.7 ± 0.19^{e}
Overall acceptability*	Zero Time	2.1 ± 0.2^{g}	4.3 ± 0.2^{b}	3.8 ± 0.2^{c}	3 ± 0.2^{e}
	After 10Days	1.7 ± 0.2^{h}	4.6 ± 0.2^{a}	3.2 ± 0.2^{d}	2.7 ± 0.2^{f}

* Mean values ± SE within the row & the column having different superscripts letters are significantly different ($P \leq 0.05$).

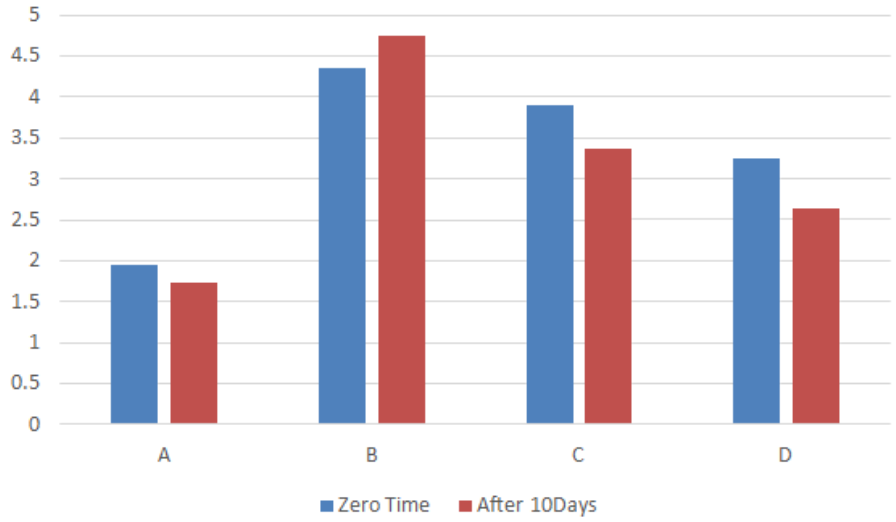

Figure (5) Appearance of cake

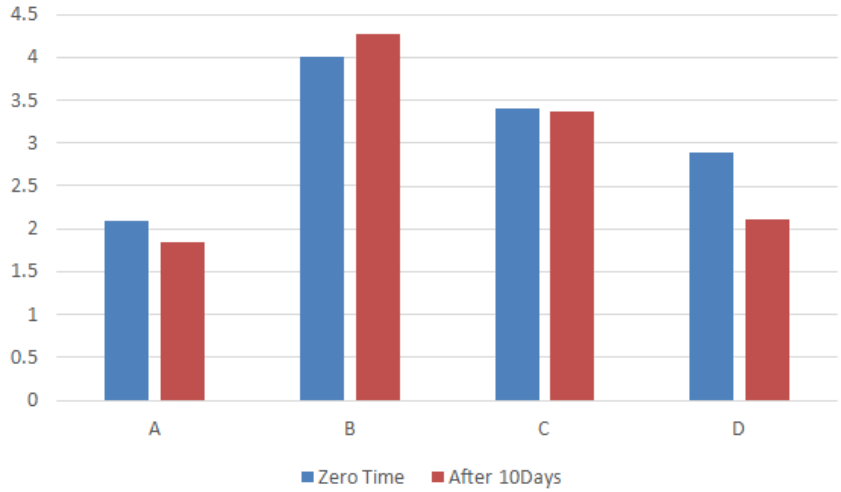

Figure (6) taste of cake

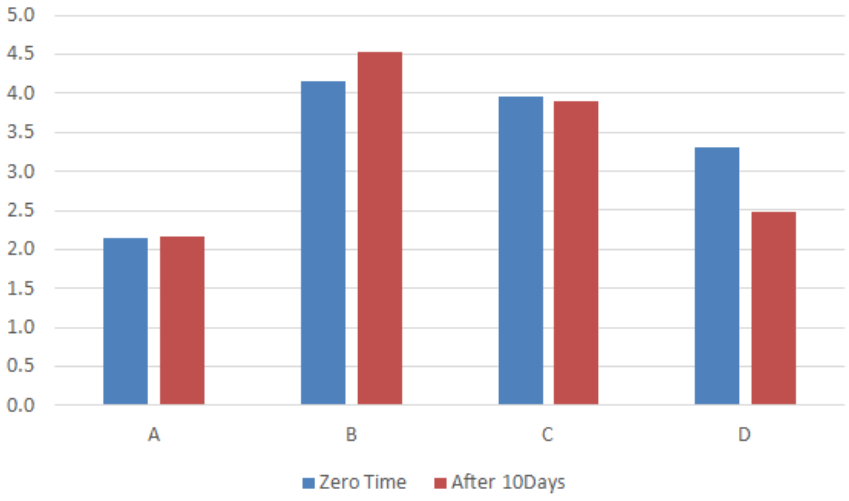

Figure (7) Texture of cake

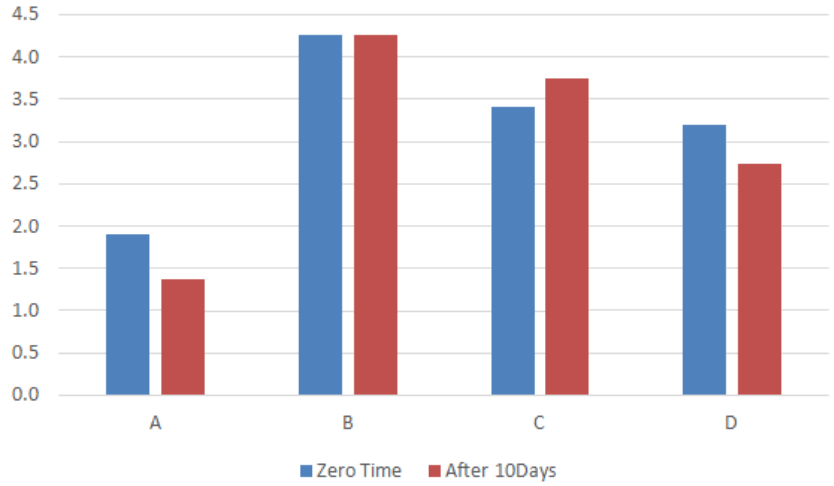

Figure (8) Flavour of cake

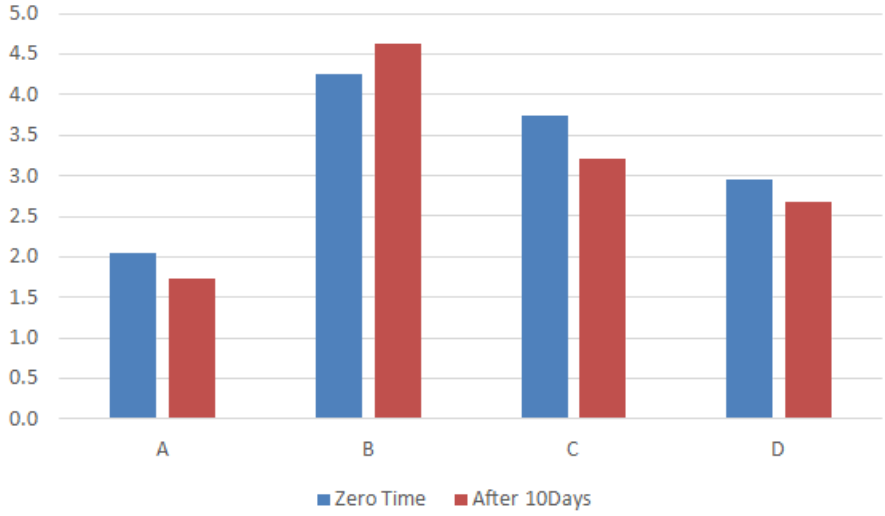

Figure (9) Overall acceptability

Conclusion: This study showed the positive impact of cake fortification with different levels of cumin oils. The oil of cake was substituted added with 0% (A), 10% (B), 5% (C) and 2.5% (D) black cumin oil. Also the result concluded that highest moisture content in sample B was decreased during storage and protein content was foundin sample D, Acidity and peroxide value were affected by the addition of cumin oil and storage period then record (0.6%) and (4.0%) respectively in all samples of cake. As well as the sensory characteristics, panelist gave the high score for cake in sample B which was added 10% nigella sativa oil, for appearance, taste, texture, flavour and overall acceptability. The study recommended the use of cumin oil by 10% of other oils in the cake industry, as it helped to preserve the product and the best sensory acceptance. Finally Cumin oil can be used to improve the preservation properties of other cereal products.

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