# Use Rosemary (*Rosemarinus Officinalis L.*) As Antioxidant And Antifungal To Extend The Shelf Life Of Cakes

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# Use Rosemary (*Rosemarinus Officinalis L.*) As Antioxidant And Antifungal To Extend The Shelf Life Of Cakes.

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**Abstract** : The purpose of this study was to determine how adding rosemary oil influenced the chemical and microbiological properties of cakes. Three samples were prepared: one with pure oil (-), one with oil plus BHT (+), and one with rosemary oil (R). A sample of rosemary oil is used as an antioxidant and antifungal to improve the shelf life of the cake. The extracted oil was tested for DPPH and Well Diffusion, as well as chemical composition (moisture, ash, protein, fat, carbs), and oil quality (peroxide value, acid value). Moisture levels were checked regularly, and obvious fungal growths on the finished product (cake) were counted weekly.We discovered that rosemary oil can be utilized as a natural antioxidant and antifungal instead of artificial preservatives to improve shelf life with comparable results. The findings revealed that rosemary oil has antioxidant activity in the cake product, as the peroxide number of the oil extracted from the cake did not exceed 10 ml equivalent/kg by the fourth week of manufacture, and the acid value did not exceed 0.6 mg/g for two weeks. The DPPH test for rosemary oil yielded an IC50 of 44 mg/mL.The findings also showed that rosemary oil had antifungal properties, as fungal growths were visible with the naked eye and began to develop after three weeks on the cake from the date of manufacturing .In conclusion, rosemary oil can be utilized as a safe natural antioxidant to prevent oxidation and extend the shelf life of cake.

**Keywords:** Rosemary ; BHT ; Peroxide Value; Acid Value; Antioxidant ; Antifungal ; DPPH ; Well Diffusion ; Chemical Composition;

## Introduction

**Teja *et al.*, (2024)** stated that the pharmacological effects of rosemary plant span from anti-inflammatory to antioxidant properties. These rosemary Officinalis also contain various chemical substances and compounds such as terpenes, essential oils, bicyclic monoterpenes, monoterpenoids, and ester, as well as pharmacological activities such as anti-oxidative, anti-inflammatory, anti-microbial, anti-obesity, anti-fungal, anti-cancer, anti-diabetic, cardiovascular activity, skin health, neuroprotective, gastrointestinal, sperm motility, antidepressant, and antiviral properties.

Medicinal plants have an important part in people's lives, not only in the discovery of new compounds with biological function, but also in the development of new therapeutic methods for illness treatment. Aside from its popularity in traditional medicine, research suggests that rosemary (Baccharis dracunculifolia) can be an effective treatment for a variety of diseases due to its biological activities, which include antitumor, antibacterial, antiviral, antifungal, antiprotozoal, anti-inflammatory, antioxidant, immunomodulatory, and analgesic properties. Given its strong pharmacotherapeutic potential, it is critical to analyze and consolidate information about rosemary's bioactive components and biomedical uses **Chammas *et al.*, (2023).**

Ninety-five rosemary (Salvia rosmarinus Schleid.) genotypes, representing 24 wild populations, were collected in various geographical areas of Italy and then cultivated under homogeneous environmental conditions to determine volatile organic compounds (**VOCs**) and three major non-volatile phenolic diterpenes (carnosic acid, carnosol) and acids **Raffo *et al.*, (2023).**

**Farhadi *et al.*, (2023)** investigated the effects of rosmarinic acid (**RA**), carnosic acid (**CaA**), rosmanol (**RO**), carnosol (**CA**), and ursolic acid (**UA**) on allergy and immunologic disorders. Rosemary's anti-cancer effects are achieved by numerous mechanisms, including DNA fragmentation, apoptosis induction, reduction of astrocyte-upregulated gene-1 expression, and blocking cell cycle progression in the G1 phase. Rosemary essential oil contains chemicals that serve as calcium antagonists, suppressing acetylcholine (**ACH**), histamine, and norepinephrine activation.

**El Boukhari& Fatimi (2023)** used patent analysis techniques to examine the patentability of rosemary-derived medications and bioactive compounds over the last two decades, as well as patent documents

relating to the rosemary (Rosmarinus officinalis Linné) plant. and focuses on pharmacological and biomedical applications, procedures for extracting rosemary-derived biomolecules (such as rosmarinic acid, carnosic acid, and carnosol), as well as cosmetic and food applications.

**Baiotto *et al.*, (2023)** determine the effectiveness of rosemary and eucalyptus essential oils in reducing plant pathogenic fungus in stored soybean seeds. The results showed that rosemary oil was helpful at reducing Penicillium sp. The results were similar to the positive control.

Data on the chemical makeup of essential oils (EO), as well as their antioxidant, antibacterial, and antifungal properties, are presented. REO antioxidant analysis yielded an IC50 value of 154.25 ± 3.11 mg·L −1, with EO exhibiting growth inhibition and bactericidal properties for several bacteria. The best results were obtained for gram-negative Escherichia coli and S. typhi (MIC and MBC values of 5.19 ± 0.08 μL·mL−1 and 20.75 ± 0.36 μL·mL−1, respectively) **Brandt *et al* .,(2023).**

Rosemary essential oil (REO),Antioxidant activity was determined by the EO's ability to trap free radicals of 2,2-diphenyl-1-picrylhydrazyl (DPPH) using a methodology adapted from **Hemmati *et al.* (2021).**

According to **Brandt *et al* .,(2023)** the **REO** has a direct effect on inhibiting the development of halos in fungi from the genera Mucor, Aspergillus, and Penicillium. It was also discovered that after seven and fourteen days of exposure to the environment, the total number of fungal mycelia in the presence of **EO** was lower than in the same **TP** sample without the chemical. However, despite the **REO's** inhibitory and bactericidal action for all bacteria tested, it was possible to observe that there was no growth of microorganisms at dilutions.

Because of its biological activity, including as anticancer, antibacterial, antiviral, antifungal, antiprotozoal, anti-inflammatory, antioxidant, immunomodulatory, and analgesic qualities, rosemary (Baccharis dracunculifolia) has been shown to be an ally in the treatment of a variety of ailments. Given its strong pharmacotherapeutic potential, it is critical to analyze and consolidate information about rosemary's bioactive components and biomedical uses **Chammas *et al.*, (2023).**

Rosemary essential oil was a possible antifungal candidate with stronger antifungal activity than fluconazole. It was fungistatic against C. albicans but fungicidal against C. non-albicans, indicating that it could be used to treat OC caused by C. non-albicans **Murtiastutik *et al.*, (2023).**

The rosemary plant (Rosmarinus officinalis) produces two primary diterpenes: carnosic acid (CA) and carnosol. They have a phenolic structural component and can eliminate cellular reactive oxygen species (ROS) directly or indirectly by upregulating antioxidant defenses **Habtemariam (2023).**

The antibacterial activities of various essential oils (lemongrass, oregano, rosemary, peppermint, and eucalyptus) were tested against Cladosporium cladosporoides, Aspergillus fumigatus, and Penicillium chrysogenum, which are typically discovered on archive materials. The use of a 1:1:1 mixture of oregano, lemongrass, and peppermint resulted in a lower minimal inhibitory concentration (0.78%) and higher efficiency during a vapour test at the highest tested distance (5.5 cm) than individual **EOs Tomić *et al.*, (2023).**

**Martínez *et al.*, (2019)** mentioned that natural extracts from leaves, peels, and seeds, such as pomegranate (**P**), rosemary (**RA**), Nutrox **OS** (**NOS**), Nutrox **OVS** (**NOVS**), and olive (Olea europaea)

extracts rich in hydroxytyrosol (HYT-F from olive fruit and HYT-L from olive leaf), can act as antioxidant and antimicrobial agents in food products, replacing synthetic additives.

The development of new curative medications and the consumption of natural dietary elements with immunomodulatory action are urgently required to reduce the population's risk of chronic diseases. Rosmarinus officinalis (Lamiaceae) is an aromatic herb that has been used traditionally and medicinally as a carminative, antispasmodic, pain reliever, circulatory tonic, hair growth stimulator, and memory improver **Ahmed & Babakir-Mina, (2020).**

**Erkan & Aşcı (2020)** reported that rosemary has long been used for its antibacterial, antifungal, and antioxidant qualities. With these characteristics, it is employed in a variety of industries, particularly food and pharmaceuticals. Rosemary essential oils enhance biological activity. Furthermore, this oil reduces lipid oxidation in foods, resulting in a longer and fresher shelf life. Rosemary's powerful antioxidant qualities prevent the damaging effects of reactive oxygen species. Rosemary's antibacterial and antifungal properties, including 1,8-cineol, camphor, Î±-pinene, carnosic acid, and carnosol, make it efficient against a wide range of diseases.

Increasing health problems caused by various pathologies such as cancers, liver diseases, and hormonal disorders caused by chemical residues in agricultural products prompted the development of natural

and environmentally friendly alternative fungicides **Najar *et al.*, (2020)** including essential oils.

This scientific study focuses on volatile essential oils, which are renowned for their benefits as natural preservatives due to their antioxidant, antifungal, and antibacterial properties, as well as their ability to treat ailments.

## Materials and Methods

## Materials:

### Plant materials

Rosemary (Rosemarinus Officinalis L.) was purchased from the local market in Giza, Egypt. rosemary leaf were washed with clean water and air-dried. Dried fruiting bodies were crushed by an electrical grinder to make powder. The powder was then stored in an exceedingly clean, dried and covered plastic container at room temperature until used.

A cake was produced with rosemary oil added as an antioxidant and antifungal to increase its shelf life. The extracted rosemary oil was tested for **DPPH** and well diffusion, as well as sensory tests (taste, smell, texture, color, porosity, general acceptance) and chemical composition. (moisture, ash, protein, fat, and carbs) were measured, as well as oil quality tests (peroxide and acid numbers). Moisture levels were examined regularly, as were fungal growths on the finished product (cake).

Three groups of cake were used:

group (1) (-): cake with oil free of antioxidants

group (2) (+): cake with oil added BHT

group (3) (R): cake with rosemary oil

### Oil extraction

Three hundred grams of fresh rosemary leaf. The foliage was rinsed with running water before fifty grams of the material were hydrodistilled in a Clevenger-for three hours. The EO extraction yield was estimated as the ratio of the mass of EO obtained following the extraction technique to the mass of the plant originally employed. To ensure oil quality for analysis and tests, rosemary oil was stored in sealed dark glass bottles under continual refrigeration at 5.0 ± 1.0 °C to prevent oxidation and light exposure.

## Methods:

All chemical analysis of extracts was done in the Food Safety and Quality Control Lab, in the Faculty of Agriculture, Cairo University, Giza, Egypt.

### Chemical Composition Of Fresh Rosemary Leaf:

Determination of moisture, proteins, fats, ash and crude fiber contents in extracts were according to **AOAC (2016)**. Protein content was determined by Kjeldahl technique **AOAC (2005)**, using a factor of 6.25, carbohydrate content was determined using the **AOAC (2000)** difference.

Total carbohydrates = 100 - (g protein+ g fat +g ash + g fiber).

### DPPH Radical-Scavenging Activity

A sample of fresh rosemary leaf (0.1 g ) was prepared in 50ml methanol. An aliquot of the extract was added to DPPH radical (100 µl, 0.2 mM) dissolved in methanol. The mixture was stirred and left to stand for 15 minutes in the dark. Then the absorbance was measured at 517 nm against a blank. Percentage scavenging effect was calculated as: [(A0 – A1) / A0] × 100 where: A0 is the absorbance of the control (without sample) and A1 is the absorbance in the presence of the sample **Brand-Williams*, et al.*, (1995)**.

### Well Diffusion

According to the procedure of **Jahangirian *et al* .,(2013).**

1- Pour two plates of mold and yeast environment, and leave them for three days.
2- A sterilized inoculation needle is inserted in a sterile saline solution, followed by a swab of Aspergillus niger, which is plotted on a slanted agar medium and incubated at 28°C for 3-5 days.
3- A sterilized inoculation needle is inserted in a sterile saline solution, followed by a Penicillium sp. swab. Then, plan onslanted agar medium and incubate at 28°C for 3-5 days.
4- 2-3 ml of sterile saline is applied to the germs developing in the tubes, and the suspension is transferred to an empty, sterile tube (for both strains).
5- Spread 0.1 ml of bacteria suspension on a plate with medium, mold, and yeast using a hockey stick. Make holes in the dish and pour 50microliters of rosemary oil in them.
6- The dishes are fortified at 28 degrees Celsius for three to five days.
7- Fungal growths are observed, and the diameter of the ring surrounding the hole containing rosemary oil is measured.

## Microbiological analysis

### Samples preparation

Twenty-five g of each sample was mixed and homogenized in a sterile mixer, and diluted with buffered peptone water to make the sufficient dilutions for the microbiological analysis. Ten-folds dilutions of homogenates or liquid samples were prepared and inoculated into plates of selective media.

### Yeasts and moulds count

Enumeration of yeasts and moulds were carried out using the potato dextrose agar medium. Plates were incubated at 22-25º C for 3-5 days, and colonies of yeasts and moulds were counted and calculated per gm or ml of sample **FDA (2002)**.

### Determination of peroxide and acid values

Peroxide and acid values of samples were determined according to **AOAC (2005)**.

### Cakes Preparation

Cakes were prepared according to the formula shown in **table (1)**, and using the method as described by **Hamed (1993)** with some modification. The ingredients including sugar, eggs and vanilla were homogenized with an electric mixer at medium speed for 20 minute; added the butter for 5 minute; and milk was added and mixed well. The blends of wheat flour were mixed manually with baking powder. The butter was placed into tin mold pans size 30 and baked in a conventional oven pre-heated to 1800C for 30 minute, air cooled at room temperature and packed.

**Table (1) Samples Components and Quantities**

| Ingredients/ Amounts | Control Negative ( - ) | Control Positive ( + ) | Treatment ( R) |
|---|---|---|---|
| **Wheat Flower** | 333.33 | 333.33 | 333.33 |
| **Eggs** | 165 | 165 | 165 |
| **Sugar** | 166.66 | 166.66 | 166.66 |
| **Milk(** ml) | 110 | 110 | 110 |
| **Baking Powder** | 32 | 32 | 32 |
| **Vanilla** | 2 | 2 | 2 |
| **Oil free of antioxidant** | 100 ml | 100 ml | 100 ml |
| **BHT** | ----- | 200 ppm | ------ |
| **Rosemary Oil** | 200 ppm | ------ | ------ |

(BHT: Butylated Hydroxytoluene) (-): cake with oil free of antioxidant، (+): cake with oil added BHT، (R): cake with rosemary oil

## Statistical analysis

One-way ANOVA was used for the statistical analyses, which were performed in triplicates. The data were expressed as mean ± standard deviation with a p value confidence level of < 0.05. **Snedecor and Cochran, (1989).**

## Results and Discussion

## Oil test

### 1-DPPH Test

The data given show that the higher the concentration of the oil, the larger the rate of inhibition, or the rate of free radical elimination. As a result, the oil's antioxidant activity increases with its concentration

**Table (2): DPPH Test For Rosemary Oil**

| Concentration | %inhibition |
|---|---|
| 1 | 1.30 |
| 10 | 37.42 |
| 100 | 72.00 |
| 200 | 82.32 |

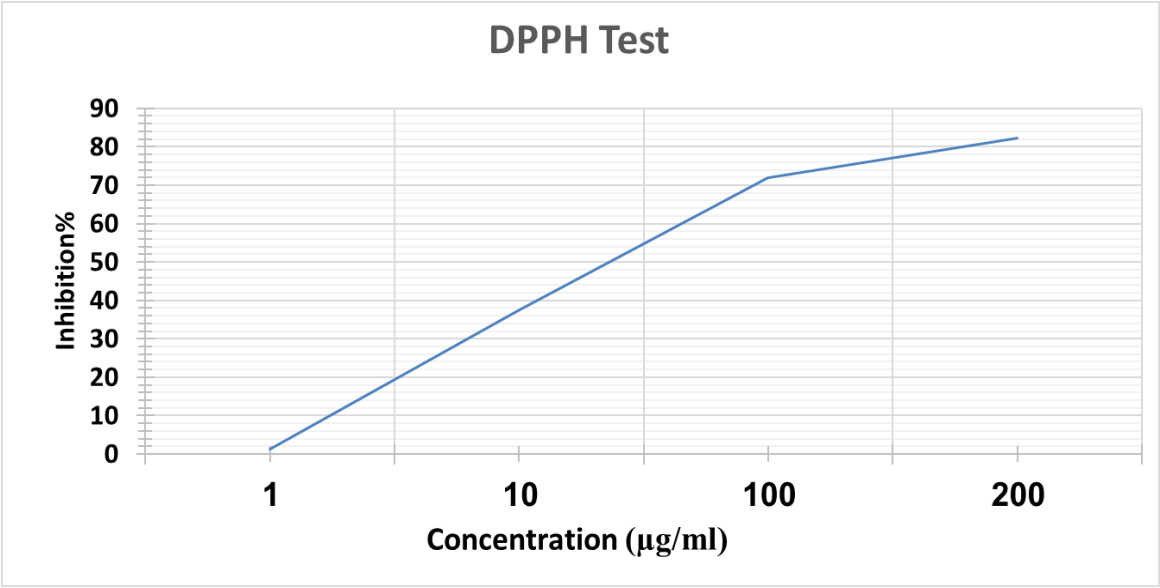



**Figure 1: DPPH Test For Rosemary Oil**

The equation was y = 27.764x - 21.145, with $R^2$=0.9525. where $IC_{50}$ =44µ g /ml

In this respect, **Saini *et al.* (2020)** mentioned that Increasing the extract concentration greatly boosts radical-scavenging action. The RE's hydrogen-donating activity neutralized DPPH free radicals by

41.25%, 50.45%, 55.56%, 61.28%, and 65.28% at doses of 20, 40, 60, 80, and 100 µg/ml, respectively.

**2-Well Diffusion Test**

**Table (3) : Radii Of Clear Zone For Rosemary Oil**

| Type of fungi | Radii of clear zone(cm) | Mean (cm) |
|---|---|---|
| Penicillium sp. | 0.8 ، 1 | 0.9 |
| Aspergillus niger | 0.3 ، 0.3 | 0.3 |

Asperagillus niger Penicillium sp.

Figure 2 : Radii Of Clear Zone For Rosemary Oil

This test produced a clear zone at the two spots where rosemary oil was applied to the hole in each of the petri dishes harboring Penicillium sp. and the petri dish with Aspergillus niger. He averaged the radii of the two circles in each dish. While the diameter of the inhibitory zone was 1.42 cm for the dish in which the Aspergillus niger fungus was put, the oil was poured within the hole in the amount of 100 microliters of rosemary oil at a concentration of 2.5 ml/mg.

Cinnamon essential oil showed antifungal action against Aspergillus niger 103 by damaging the cell wall and cell membrane and limiting normal growth**Wang *et al* ., (2023)**

**Felšöciová *et al.* (2020)** added 20 µl rosemary oil at 0.50 µl/ml. Penicillium species include P. brevicompactum (0.55), P. citrinum (0.2), and P. crustosum (0.2).

**da Silva., *et al.* (2020)** investigated the antifungal and antiaphylatoxigenic activity of REO against Aspergillus flavus in their study. At a concentration of 250 µg/mL, A. flavus was shown to inhibit mycelial growth by 15.3%. Furthermore, increasing the treatment concentration has been shown to reduce ergosterol synthesis and mycelium biomass.

## Chemical Composition Test

Data in **table (4)** displayed that Sample (R) contains the most fat and protein, as well as an average amount of moisture and carbs, whereas sample (+) has the least fat and the most carbohydrates and moisture. On the other hand, the fiber % was similar in terms of fiber content. Protein percentages ranged from 6.43 to 7.01, fat percentages from 34.5 to 42.5%, moisture from 16.88 to 19.69, ash from 1.10 to 1.68, and carbs from 29.92 to 36.39.

**Table (4) Chemical Composition For Samples**

| Sample | % Moisture | % Ash | % Fat | % Protein | % Carbohydrate | %Fiber |
|---|---|---|---|---|---|---|
| ( - ) | 16.88 | 1.22 | 39.5 | 6.43 | 35.25 | 0.72 |
| ( + ) | 19.69 | 1.68 | 34.5 | 7.01 | 36.39 | 0.72 |
| ( R ) | 18.75 | 1.10 | 42.5 | 7.01 | 29.92 | 0.72 |

(BHT: Butylated Hydroxytoluene) (-): cake with oil free of antioxidant، (+): cake with oil added BHT، (R): cake with rosemary oil

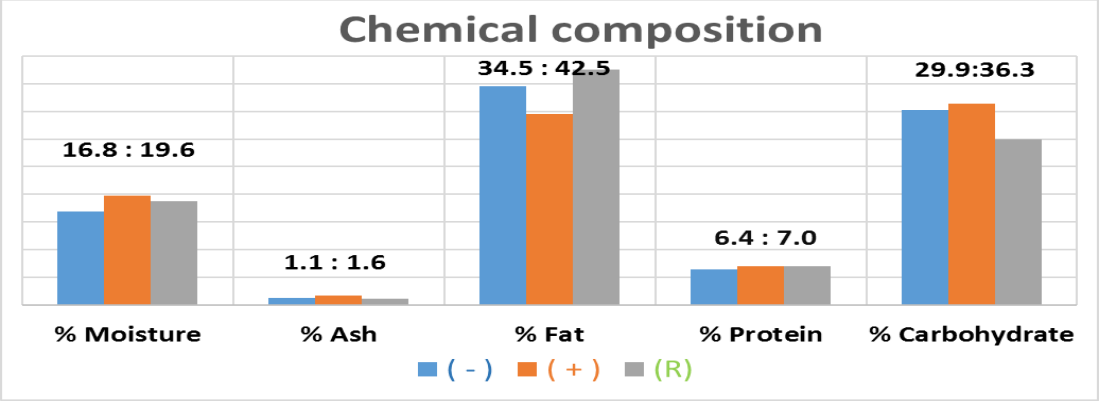



**Figure3: Chemical Composition For Samples**

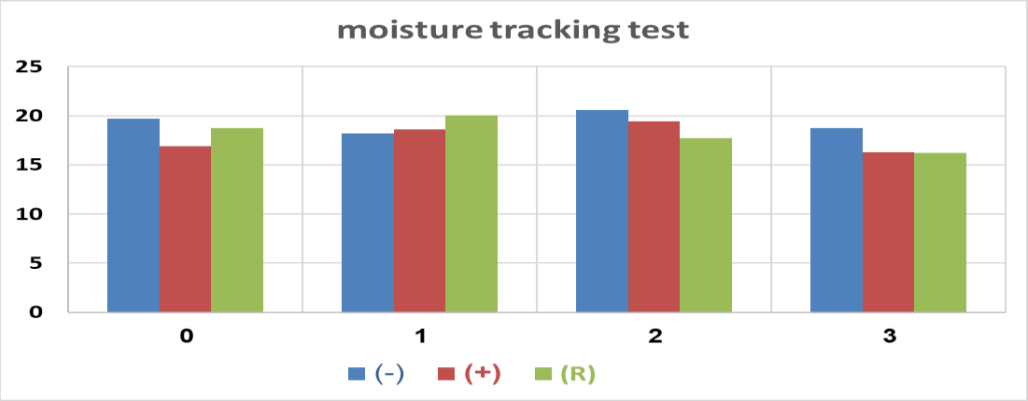
## Moisture Tracking Test

**Table (5) Moisture Tracking For Samples**

| Time (Week) | (-) | (+) | (R) |
|---|---|---|---|
| 0 | 19.69 | 16.87 | 18.74 |
| 1 | 18.22 | 18.57 | 20.05 |
| 2 | 20.56 | 19.39 | 17.71 |
| 3 | 18.77 | 16.27 | 16.21 |

(-): cake with oil free of antioxidant، (+): cake with oil added BHT، (R): cake with rosemary oil

The previous results indicate that humidity levels converged over four weeks, with a range of 16.21 to. 20.05




**Figuer 4: Moisture Tracking Test For Samples**

## Quality Rosemary Oil test For Cake :

### Peroxide Value Test

Peroxide value is a sign of the commencement of oxidative changes in oil and fats caused by the oxidation of unsaturated fatty acids and the creation of peroxides, as well as the hydrolysis of glycerides, which leads to a rise in free fatty acid content **(Riuz *et al.*, 2001)**. The standard states that a good oil should not have a peroxide number greater than 10 milliequivalents per kg.From the obtained results in **table (6),** it could be observed that the crude oil sample (-); the peroxide number climbed rapidly from the week of manufacture until it exceeded 10 before the third week. While the oil sample had an artificial antioxidant added to it (+), it showed that the peroxide number was stable from the week of manufacturing until the second week, when it was equal to zero, indicating that no oxidation process occurred during this period, but then suddenly increased until the third week, when it began to rise dramatically. It was typical until the fourth week, however despite the increase, the peroxide number did not reach 10, indicating a powerful effect but a low stability rate. On the other hand, it was discovered that in the sample of oil to which rosemary oil (R) was added, the peroxide number increased at a very slow rate, as the value was less than one from the week of manufacturing until the third week, but a sudden increase occurred until the fourth week, and despite the increase, the peroxide number did not exceed It has 10, and its stability rate is larger than that of the (+) sample.

These findings align with **Choi *et al* .,(2019)** who stated that the peroxide value of the lard oil increased during storage, from 27.71 to 454.95 meq/kg in the control group (with no antioxidant added to the

lard oil). The peroxide value of the lard oil with added antioxidants rose in the following manner: 26.61 to 433.77 meq/kg in the carnosic acid + carnosol group; 27.22 to 429.34 meq/kg in the carnosol group; 26.84 to 416.71 meq/kg in the carnosic acid group; 27.09 to 414.69 meq/kg in the rosemary leaf extract group; and 27.12 to 107.52 meq/kg in the BHA group.

**Table (6) Peroxide Value Test For Samples**

| Time (Week) | (-) | (+) | (R) |
|---|---|---|---|
| 2 | 4.41 | 0 | 0.76 |
| 3 | 10.89 | 4.90 | 1.26 |
| 4 | 20.96 | 5.34 | 8.39 |

(-): cake with oil free of antioxidant، (+): cake with oil added BHT، (R): cake with rosemary oil

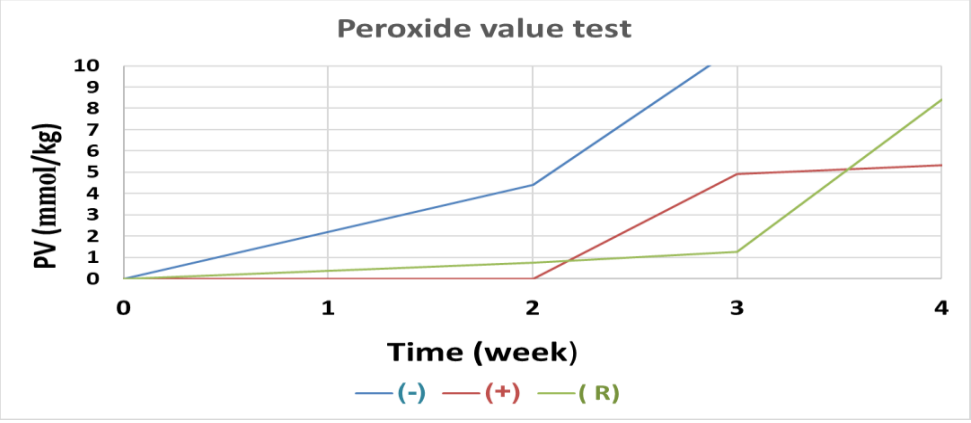



**Figure 5: Peroxide Value Test For Sampels**

## 2-Acid Value Test for Samples

### Acid value

The criterion states that a good oil should not have an acid value more than 0.6 mg/g.Data shown in **Table (7)** illustrate the changes in the 63acid values expressed as mg NaOH/g fat of different treatments as affected by using: cake with pure oil (-) , cake with oil added BHT(+) and cake with rosemary oil(R) during the incubation period at 63± 1°C

**Table (7) Acid Value Test For Samples**

| Time (week) | (-) | (+) | (R) |
|---|---|---|---|
| 0 | 0.52 | 0.47 | 0.32 |
| 3 | 0.71 | 0.54 | 0.83 |
| 4 | 0.73 | 0.57 | 0.85 |

(-): cake with oil free of antioxidant، (+): cake with oil added BHT، (R): cake with rosemary oil

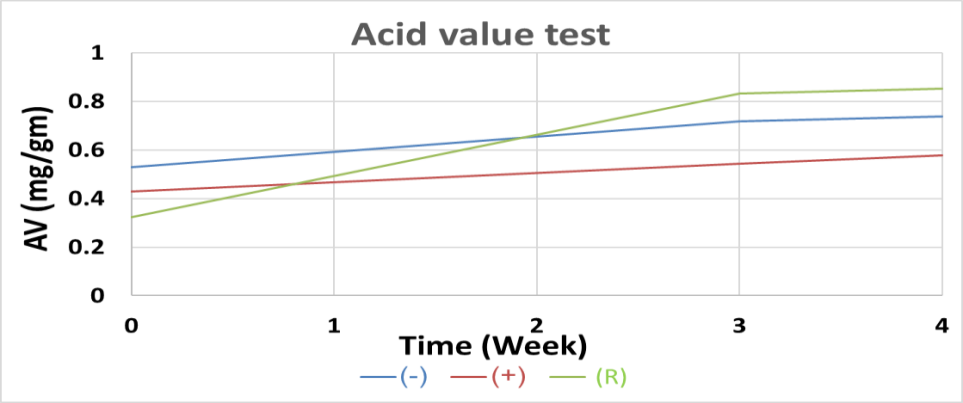



**Figure 6: Acid Value Test For Samples**

for 28 days. Results are shown ,crude oil sample (-) , and the acid number has been above 0.6 from the first week.Sample of oil with an artificial antioxidant (+) added, the acid number climbed slowly from the first week of manufacturing to the fourth week, never exceeding 0.6, indicating a high level of stability. Sample with rosemary oil added. Its acid number was lower than that of the (+) sample at the start of the first week, but it began to increase at a rapid pace, so its acid number was within the specification, that is, it did not exceed 0.6 for two weeks, because its stability rate was lower than that of the (+) sample.

These results are in agreement with **Choi *et al* .,(2019)** who found that the acid value of the lard oil increased after storage, from 0.56 to 8.56 mg KOH/g in the control group (no antioxidant was added). The acidity of the lard oil with added antioxidants increased as follows: From 0.56 to 4.83 mg KOH/g in the carnosic acid + carnosol group; 0.56 to 4.84 mg KOH/g in the carnosol group; 0.56 to 4.65 mg KOH/g in the carnosic acid group; 0.56 to 3.53 mg KOH/g in the rosemary leaf extract group; and 0.56 to 1.67 mg KOH/g in the BHA group.

Also,**Temelkovska *et al.* (2021)** found that after one, two, and three weeks of storage, all oils with added rosemary had a peroxide value of 0 mmol O2/kg, indicating no oxidation independent of volume in the container. The rosemary oil has remained oxidation-free for three weeks due to its antioxidant properties.

**Track growth of fungi test for samples**

The **table** (**8**) shows how rosemary oil affects the product's shelf life. Cake sample with additional rosemary oil (R). No fungi grew on it until the second week, and a small amount began to develop in the third

week. Cake sample containing crude oil (-) and artificial antioxidant (+) Both are free of antifungals, so they produced the same result: spoiling began in the first week and increased until the third week.

**Table (8) The Result Visually Tracks The Growth Of Fungi For Samples**

| Time (Week) | (-) | (+) | (R) |
|---|---|---|---|
| **0** | - | - | - |
| **1** | + | + | - |
| **2** | ++ | ++ | - |
| **3** | +++ | +++ | + |

(-): cake with oil free of antioxidant، (+): cake with oil added BHT، (R): cake with rosemary oil

## Conclusion

We discovered that rosemary oil can be utilized as a natural antioxidant and antifungal in place of industrial preservatives to improve shelf life with results comparable to industrial preservatives. The findings revealed that rosemary oil has antioxidant activity in the cake product, as the peroxide number of the oil extracted from the cake did not exceed 10 ml. equivalent/kg by the fourth week after the cake was manufactured, and the acid number did not exceed 0.6 mg/g for two weeks. The DPPH test for rosemary oil yielded an $IC_{50}$ value of 44 mg/ml.The results also revealed that rosemary oil has antifungal properties, as fungal growths were detected with the naked eye and the fungi began to grow after three weeks on the cake from the day of creation. A thorough discussion test was carried out, and a clean zone was found in the dishes for Aspergillus niger and Penicillium sp. Their radii measured 0.3 and 0.9, respectively.

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# استخدم إكليل الجبل كمضاد للأكسدة ومضاد للفطريات لإطالة مدة صلاحية الكيك

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**ملخص البحث**

كان هدف هذا البحث هو معرفة كيف يؤثر إضافة زيت إكليل الجبل على الصفات الكيميائية والميكروبيولوجية للكيك. تم تحضير ثلاث عينات من الكيك: واحدة بزيت نقي (−)، وواحدة بزيت مضاف إليه (+) BHT، وواحدة بزيت إكليل الجبل (R) عينة تحتوي على زيت إكليل الجبل كمضاد للأكسدة ومضاد للفطريات لإطالة العمر الافتراضي للكيك. خضع زيت إكليل الجبل المستخرج لاختبارات DPPH و Diffusion Well، بالإضافة إلى اختبارات التركيب الكيميائي (الرطوبة والرماد والبروتين والدهون والكربوهيدرات) واختبارات جودة الزيت (رقم البيروكسيد و الرقم الحمضي). تمت مراقبة الرطوبة أسبوعيًا، وتم تتبع النمو الفطري المرئي على المنتج النهائي (الكيك) أسبوعيًا. لاحظنا أنه يمكن استخدام زيت إكليل الجبل كمضاد للأكسدة ومضاد للفطريات طبيعي بدلاً من المواد الحافظة الاصطناعية لإطالة العمر الافتراضي بتأثيرات مكافئة. وأظهرت النتائج أن زيت إكليل الجبل له نشاط مضاد للأكسدة في منتج الكيك، حيث لم يصل رقم البيروكسيد للزيت المستخرج من الكيك إلى 10 مل مكافئ/كجم بحلول الأسبوع الرابع بعد التصنيع، ولم تتجاوز القيمة الحمضية 0.6 ملجم/جم لمدة أسبوعين. وأظهر اختبار DPPH لزيت إكليل الجبل أن $IC_{50}$ يبلغ 44 ملجم/مل. كما أظهرت النتائج أن زيت إكليل الجبل له خصائص مضادة للفطريات، حيث شوهدت النموات الفطرية بالعين المجردة، وبدأت الفطريات في التكاثر بعد ثلاثة أسابيع على الكيك. كما أظهرت النتائج أن زيت إكليل الجبل له خصائص مضادة للفطريات، حيث شوهدت النموات الفطرية بالعين المجردة وبدأت في النمو بعد ثلاثة أسابيع من تصنيع الكيك. يوصي باستخدام زيت إكليل الجبل كمضاد للأكسدة طبيعي وآمن لمنع الأكسدة وإطالة العمر الافتراضي للكيكة.

**الكلمات المفتاحية:** إكليل الجبل؛ BHT؛ ؛ مضاد للأكسدة؛مضاد للفطريات؛ DPPH ؛ رقم البيروكسيد ؛ الرقم الحمضي