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Al-Anbari & Ali

المجلة العراقية لبحوث السوق وحماية المستهلك

THE USE OF ULTRAVIOLET RAYS TO PRESERVE FERMENTED GREEN OLIVES AND ITS EFFECTS ON CHEMICAL PROPERTIES OF ITS EXTRACTED OIL

Iman H. Al-Anbari[1], Taghreed I. Ali[2]
[1]Professor PhD., Food sciences department, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq, dr.imanh.alanbari@coagri.uob.edu.iq.
[2]Researcher, Food Sciences Department, College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq, taghreedibrahimali@gmail.com

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ABSTRACT

This study was conducted to see the effect of ultraviolet rays 15W on some chemical properties of olive oil when using it to preserve green olive pickles, treated for 5, 10 and 15 min daily. green olive fruits Iraqi variety (al-ashrasi), in season (2020-2021) were pickled using Spanish style, the best time period to preventing characteristics changes on oil extracted form treated pickles was tested. the results of this study showed the chemical tests for the oil extracted from pickled olives during the fermentation stages. the results recorded after 30 day pickling condition for acid number (FFA) for control (untreated with UV) was 1.62%, while the other treatments which treated with ultraviolet rays for 5, 10 and 15 min daily recorded 0.41, 0.44 and 0.46% respectively. peroxide value of control treatment, recorded a significant increase ($p \leq 0.05$)), it amounted to 2.59 meq O_2/kg oil, while treated samples were recorded 0,53, 0.56 and 0.56 respectively.

Keywords: Olive oil, ultraviolet, free fatty acids, peroxide value, thiobarbituric acid.

استخدام الأشعة فوق البنفسجية لحفظ الزيتون الأخضر المتخمر وتأثيراته على الخصائص الكيميائية لزيته المستخلص

ايمان حميد الأنباري[1]، تغريد ابراهيم علي[2]
[1]استاذ دكتور، قسم علوم الاغذية، كلية علوم الهندسة الزراعية، جامعة بغداد، بغداد، العراق. dr.imanh.alanbari@coagri.uob.edu.iq
[2]باحثة، قسم علوم الاغذية، كلية علوم الهندسة الزراعية، جامعة بغداد، بغداد، العراق. taghreedibrahimali@gmail.com

الخلاصة

تناولت هذه الدراسة تأثير الأشعة فوق البنفسجية 15واط على بعض الخواص الكيميائية لزيت الزيتون عند استخدامه لحفظ مخللات الزيتون الأخضر، حيث تعرضت لمدة 5 و10 و15 دقيقة يوميا، وتم تخليل ثمار الزيتون الاخضر العراقي (الاشرسي) في موسم 2020-2021 بالطريقة الاسبانية، وتم اختبار أفضل فترة زمنية لمنع تغيرات الخصائص للزيت المستخلص في المخللات المعاملة بالاشعة فوق البنفسجية، أظهرت نتائج هذه الدراسة الاختبارات الكيميائية للزيت المستخرج من مخلل الزيتون خلال مراحل التخميربعد 30 يوم من التخليل للاحماض الدهنية الحرة (FFA) لمعاملة السيطرة (غير المعالجة بالأشعة فوق البنفسجية) كانت 1.62%، بينما سجلت المعاملات الأخرى التي تعرضت للاشعة فوق البنفسجية لمدة 5 و10 و15 دقيقة يوميا 0.41 و0.44 و0.46% على التوالي، وسجلت قيمة البيروكسيد لمعاملة السيطرة زيادة معنوية ($P \leq 0.05$) والتي بلغت 2.59 meq O_2/kg، بينما سجلت المعاملات بالزيت 0.53 و0.56 و0،56على التوالي، أما بالنسبة لحامض الثيوباربيتوريك (TBA) نلاحظ زيادة معنوية بين معاملة السيطرة والتي سجلت 1.62 مقارنة بالمعاملات بالأشعة فوق البنفسجية (15 واط)، وللفترات الزمنية السابقة، اذ سجلت 0.46 و0.44 و0.41 على التوالى.

الكلمات المفتاحية: زيت الزيتون، الأشعة فوق البنفسجية، الحوامض الدهنية الحرة، رقم البيروكسيد، حامض الثايوباربتيوريك.

INTRODUCTION

The recent years have witnessed an increasing in the demand for functional foods, including those that contain therapeutic bacteria because of consumers usefulness of therapeutic bacteria on human health **(Jose *et al.*, 2015)**. Lactic acid fermentation is one of the most important types of food fermentation, and it means the total of the biological changes responsible for the decomposition of carbohydrates by converting the sugars (glucose, lactose) by the action of lactic acid bacteria and their enzymatic systems, thus enhancing the taste, flavor, smell and color of these products resulting from the accumulation of fermentative metabolites such as lactic acid And other compounds that give the distinctive flavor of lactic pickles, in addition to their nutritional and health benefits in maintaining the integrity of the digestive system, **(Sanlier & Gokcen 2019; Elshikha 2018., Behera *et al.*, 2020)**.

Green olive pickles have high nutritional value due to their content of probiotics produced by lactic acid bacteria, which are considered as therapeutic nutrients. Therefore, pickled olives are considered a promising functional food **(Montoro *et al.*, 2016)**. The process of lactic fermentation of green olives takes place after removing part of the bitterness then placed it in saline solution that ensures the activity of lactic acid bacteria **(Rejano *et al.*, 2010)**. Pollution in the environment of lactic fermentation of green olives leads to many changes its compounds that make up olives, including changes in the nature of the oil, which leads to a high percentage of free fatty acids **(Bonatsou *et al.*, 2017)**.

There are many ways to preserve pickles from spoilage, such as controlling the processing conditions at the optimum temperature, which is within 25 ºC, and immersing the fruits in a saline solution with the appropriate concentration and providing anaerobic conditions, **(Eze *et al.*, 2019).**

There are many technologies to preserve food spoilage **(Al-Anbari *et al.*, 2019; Al-Anbari *et al.*, 2021**). Ultraviolet rays were used in food processing to prevent the growth of microorganisms on pickles surface by using low doses to avoid changes in the quality characteristics of processed foods, it is an emerging technology for processing many foods and extending their shelf life of foods without dangerous changes in quality **(Rahman 2020).**

MATERIAL AND METHODS

Green olive

Green olives (50 kg) for the agricultural season (October 2020-2021), Iraqi variety (Al-Ashrasi) from AL- Mosul city (northern Iraq) was used to pickled.

preparing pickles

Olives fruit were cleaned and grading, then fruits were immersed in 2% sodium hydroxide for 5 hr until the bitterness was removed from two thirds of the fruit to give the desired light bitterness taste in pickles .Than fruits washed several times with tab water until all sodium hydroxide was removed by using phenolphthalein dye as detector reagent by making a cross-section of the fruits When the pink color appeared, an indication of the disposal of sodium hydroxide, after which the process of washing with water well **(Montano & Sánchez 2021)**. After the bitterness was removed, the olive fruits were placed in a Saline solution 12.5% sodium chloride for four days, during which the concentration was adjusted until the saline concentration was stable at 10% **(Al-Saad 2009)**. Fermentation conditions were activated at room temperature of 25±2ºC **(Eze *et al.*, 2019)**. Olives were divided into 5 kg jars, and the jars were sealed with UV lamps using a voltage of 15 watts and for different periods of time 5, 10 and 15 min daily. As for the distance between the surface of the pickled olive model and the source of ultraviolet rays (bulbs) approximately 10 cm **(Rupiasih *et al.*, 2013)**. Every jar was

treated with ultraviolet rays once daily until the end of fermentation after 30 day (until the acidity reached 1.5 as lactic acid), then all tests were done every five days.

Oil sample extraction

Olive oil was extracted from green olive under fermented condition during 30 day from its pulp by cold extraction using pressure with the equipped mill from Tina company. Then, oil was kept in dark closed jar in freezer (-18ºC) until analysis were done.

Oil sample analysis:

The following parameters were determined Within 30 day: free fatty acids, peroxide values (PV), Thiobarbituric acid.

Determination of free fatty acids (FFA)

The free fatty acids were estimated according to the method mentioned in **AOAC (2008)**.

Determination of peroxide value (PV)

The peroxide value was estimated as;(meq O_2/kg oil) according to the method described by **AOAC (2008)**.

Determination of Thiobarbituric acid (TBA)

TBA was determined official method of the American Society of Oil Chemistry according **AOCS (2001)** numbered Cd 91-90.

Statistical analyses

The statistical program used statistical analysis **SAS (2012)** in analyzing the data to study the effect of different treatments on the studied traits according to a complete random design (CRD), and the significant differences between the means were compared with the least significant test (LSD).

RESULTS AND DISCUSSIONS

The effect of ultraviolet rays on Free fatty acids

The exposure of olive fruits to damage or degradation for any reason reduce its oil quality, and checking the acidity of the oil is one of the indicators for the deterioration of its quality. The regulations indicate that the acidity of extra virgin olive oil should never exceed the level of 0.7 The effect of ultraviolet rays on oil acidity of oil which extracted from the pulp of olive during the fermentation period 30 day was showed in (Table 1), there are significant differences ($P \leq 0.05$) between the control treatment (without using UV rays) and all other treatments that have been irradiated with UV, for time periods of UV ray exposer 5, 10 and 15 min daily.

Table (1) The effect of using ultraviolet rays 15 watts on oil acidity (FFA%) extracted from pickled olives during the fermentation period 30 day.

Time in day / samples	0	5	10	15	20	25	30
T_0	0.30	0.55	0.77	0.96	1.13	1.36	1.62
T_1	0.30	0.30	0.33	0.34	0.34	0.39	0.41
T_2	0.30	0.31	0.36	0.37	0.40	0.41	0.44
T_3	0.30	0.33	0.37	0.39	0.41	0.44	0.46
LSD	0.107	0.166	0.271	0.306	0.382	0.429	0.475
	NS	S	S	S	S	S	S

T_0: without treatment; T1: 5 min exposure to 15 W; T_2: 10 min exposure to 15 W; T_3: 15 min exposure to 15W; NS: Non-Significant; S: Significant.

There is high percentage of free fatty acids in the control treatment compared to other treatments, the reason for this may be the growth of contaminated organisms on the surface of the pickle, which led to production of lipolytic enzymes, which led to the decomposition of olive oil in the pulp of the fruits .This is consistent with what was found by (**Pérez *et al.* 2016)**.It is also noted from the results that the effect of ultraviolet rays on the decomposition of the free fatty acids of olive oil extracted from olives during the fermentation stages was slight compared to the control treatment and this is consistent with **Chawla *et al.* (2021)** found observed when sterilizing milk, whether raw or pasteurized by ultraviolet rays They found that these rays sterilized the milk without affecting the fatty acids in the milk. All treated samples which treated with UV. for 5, 10 and 15 min have free acidity did not exceed the limit of 0.8% established for the best-commercial-quality olive oil, designated extra virgin olive oil **(IOC 2003)**.

The effect of ultraviolet rays on peroxide value

(Table 2) shows the effect of ultraviolet radiation on the peroxide number of fermented green olive oil during 30 day, peroxide values of all treatments in this study were below the limit of 20 meq O_2/kg of oil, which is accepted as the limit for extra-virgin olive oil quality. There are significant differences ($P \leq 0.05$) between the control treatment and other treatments.

Table (2): Effect of using ultraviolet rays on the peroxide number (meq O_2/kg oil) of oil extracted from pickled olives during the fermentation period 30 day.

Time in day / samples	0	5	10	15	20	25	30
T_0	0.5	0.43	0.87	1.49	2.59	3.21	3.92
T_1	0.5	0.5	0.52	0.52	0.53	0.54	0.56
T_2	0.5	0.52	0.52	0.54	0.56	0.56	0.58
T_3	0.5	0.52	0.52	0.54	0.56	0.56	0.59
LSD	0.122	0.175	0.392	0.588	0.621	0.705	0.684
	NS	NS	NS	S	S	S	S

T_0: without treatment; T1: 5 min exposure to 15 W; T_2: 10 min exposure to 15 W; T_3: 15 min exposure to 15W; NS: Non-Significant; S: Significant.

We note that the control treatment recorded Significant increase in peroxide values after 15 day compared with other treatments, because of its microbial contamination that may have enzymes which occurrence of olive oil oxidation during the fermentation stages, and this is consistent with what was found by **Al-Shawi & Alneama (2021)** found a series of aldehydes and ketones in olive pickles resulting from its oil oxidation. other treatments exposed to ultraviolet rays T1, T2 and T3, peroxide value did not rise significantly, they recorded 0.56, 0.58 and 0.59 meq O_2/kg oil, respectively, as we note the efficiency of ultraviolet rays in sterilizing the surface of pickled olives without being affected. on fermented olive oil after 30 day of pickling, this is consistent with what **Corrales *et al.* (2012)** found They produced tiger nut milk with starch, and due to its inability to use heat to sterilize it due to the presence of starch and its influence by heat, they used ultraviolet rays to sterilize it and led to the disruption of polluting microorganisms with high efficiency and increase the shelf life without affecting the fats and their level of oxidation.

The effect of ultraviolet rays on the percentage of thiobarbituric acid (TBA)

The thiobarbituric acid (TBA) test measures malonaldehyde (MDA) produced due to the oxidation of fatty acids with three or more double bonds, and it measures other TBA

reactive substances such as 2-alkenals and 2,4-alkadienals **(Charles Bai *et al.*, 2022)**. (Table 3) shows the effect of ultraviolet radiation on the percentage of thiobarbituric acid (TBA) extracted from fermented green olive oil during a period of 30 day, there were significant differences (P≤0.05) between the control treatment and other treatments.

Table (3): The effect of using ultraviolet rays 15W on the percentage of thiobarbituric acid (TBA) (mg malonaldehyde/kg oil) extracted from pickled olives during the fermentation period 30 day.

Time in day / samples	0	5	10	15	20	25	30
T_0	0.023	0.045	0.088	0.109	0.124	0.140	0.198
T_1	0.023	0.023	0.027	0.030	0.031	0.031	0.032
T_2	0.023	0.025	0.026	0.031	0.033	0.034	0.034
T_3	0.023	0.025	0.028	0.031	0.034	0.037	0.039
LSD	0.013	0.028	0.0391	0.0447	0.0452	0.0493	0.0629
	NS	NS	S	S	S	S	S

T_0: without treatment; T1: 5 min exposure to 15 W; T_2: 10 min exposure to 15 W; T_3: 15 min exposure to 15W; NS: Non-Significant; S: Significant.

We note a high percentage of thiobarbituric acid in the control treatment compared to the rest of the other treatments, and the reason is the exposure of the control treatment to polluting microbes and the effect on olive oil, its decomposition and oxidation, and thus the liberation of aldehydes and ketones, and this is consistent with what was found by **Al-Shawi & Alneamah (2021)**, where he found a series of aldehydes and ketones as a result of the spoilage of pickles resulting from the oxidation of fats. It also agrees with the findings of **Izmirlioglu *et al.* (2020)**. They observed that when walnuts were exposed to ultraviolet radiation with a wavelength of 280 nm, its sterilized walnuts without affecting their chemical properties, especially walnut oil.

CONCLUSIONS

The results of the research were noted the possibility of using ultraviolet rays for periods of time 5, 10 and 15 min daily to sterilize the surface of green olive pickle without side effect on qualitative characteristics of olive oil extracted from the pulp of the fruits after fermentation process 30 day and the best results were obtained when exposing the pickled surface to ultraviolet rays for 5 min daily. At the same time, the characteristics of olive oil extracted from the control sample were deteriorated at the end of the fermentation period because microorganisms contaminating growth on the surface of the fermenter and their production of lipolytic enzymes and the liberation of free fatty acid, and consequently the increase in both the peroxide number and the value of thiobarbituric acid (TBA), that was deteriorate oil quality.

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