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THE EFFECT OF ESSENTIAL OIL OF BASIL (*OCIMUM BASILICUM* L.) ON UV-INDUCED MUTAGENESIS IN *ESCHERICHIA COLI* AND *SACCHAROMYCES CEREVISIAE*

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Abstract — The antimutagenic potential of essential oil (EO) of basil (*Ocimum basilicum* L.) and its major constituent linalool were studied with the *E. coli* K12 and S. cerevisiae D7 assays. In the *E. coli* assay, EO and linalool inhibited UV-induced mutagenesis in a repair-proficient strain, but had no effect on spontaneous mutagenesis in repair-proficient, nucleotide excision repair-deficient, and mismatch-deficient strains. By testing participation of different mechanisms involved in antimutagenesis, it was concluded that the antimutagenic effect against UV-induced mutagenesis involved decrease of protein synthesis and cell proliferation which led to increased efficiency of nucleotide excision repair. An antimutagenic effect of basil derivatives in *S. cerevisiae* was not detected.

Key words: Basil oil, UV-irradiation, antimutagenesis, *Escherichia. coli, Saccharomyces cerevisiae*

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INTRODUCTION

A number of plant species contain biologically active compounds that promote health and provide protection from many chronic diseases. Substances with beneficial health effects, attributable to their antioxidative, antimutagenic, and anticarcinogenic properties, can be found in fruits and vegetables, as well as in medicinal and aromatic plants (K i t t s, 1994). It is assumed that their use in everyday life can be an effective way of preventing many genetic diseases, including cancer (V e r h a g e n et al., 1997; K r i s – E t h e r t o n et al., 2002). There are numerous ways in which mutagenesis can be reduced or prevented: mutagen scavenging, interference by antimutagens with DNA repair or with mutagen metabolism, and many others (D e F l o r a and F e r g u s o n , 2005).

Many essential oils and their components exhibit antiviral, antibacterial, antioxidant, and antimutagenic activities and are widely used in traditional medicine (T e p e et al., 2004; K n e ž e v i ć – V u k č e v i ć et al., 2005; M i t i ć – Ć u l a f i ć et al., 2005). Based on reported data that basil (*Ocimum basilicum* L.) and its main constituent, the terpenoid alcohol linalool, possess a strong antioxidative potential (C e l i k and Ö z k a y a, 2002; J a v a n m a r d i et al., 2003), in our previous research we focused attention on the protective effect of essential oil of basil (EO) and linalool (69.2 % in EO, Table 2) against oxidative DNA damage and mutagenesis. The mutagenic potential of EO and linalool was prescreened in the *Salmonella*/microsome mutagenicity assay (M a r o n and A m e s, 1983), and no mutagenic effect of basil derivatives was detected in any tested strain (S t a j k o v i ć et al., 2007). Inhibitory influence of EO and linalool against *t*-BOOH-induced mutagenesis was shown in the *E. coli* K12 and WP2 reversion tests, as well as against H_2O_2-induced oxidative DNA damage in the alkaline yeast comet assay (N i k o l i ć, 2004; S t a n o j e v i ć et al., 2004, 2006). These findings suggest that the antimutagenic and antigenotoxic potential of EO and linalool can be attributed to their antioxidative properties. However, inhibition of *t*-BOOH-induced microsatellite instability in *E. coli* K12 by post-treatment with EO and linalool indicated involvement of other mechanisms (N i k o l i ć, 2004).

The *E. coli* K12 assay is composed of four tests measuring different end-points at the DNA level (Vuković – Gačić et al., 2006). Antimutagenic influence against spontaneous and UV-induced mutagenesis is examined in the SY252 repair proficient strain and its IB105 nucleotide excision repair deficient *uvrA* counterpart (Test A). Spontaneous mutagenesis is also examined in the IB103 isogenic mismatch repair (MMR) deficient *mutS* strain (Test B). All strains carry an ochre mutation (*argE3*) that can revert to prototrophy by base substitutions (Tood et al., 1979). The level of SOS induction, corresponding to the induction of error-prone SOS repair (Quillard and Hofnung, 1993), is measured by monitoring the level of β-galactosidase in the IB111 repair-proficient strain lysogenized with non-inducible λ phage carrying the *sfiA*::*lacZ* fusion (Test C). The given strain is also constitutive for alkaline phosphatase, which is suitable for assessing the effect on overall protein synthesis (Berić – Bjedov, 2003). The effect on homologous recombination is measured using strains with two non-overlapping deletions in the duplicated *lac* operon, in which intrachromosomal recombination results in the formation of Lac^+ recombinants (Test D). Strain GY8281 (*recA*$^+$) is recombination-proficient, and an increased amount of activated RecA protein is formed only after DNA-damaging treatments. On the contrary, strain GY8252 (*recA730*) is partially recombination-deficient and has an increased level of activated RecA protein in the absence of DNA-damaging treatments. It follows that strain GY8252 is constitutive for SOS induction (Lavery and Kowalczykowski, 1992; Ennis et al., 1995).

To test the effect of basil derivatives in eukaryotic cells, we used the *S. cerevisiae* D7 diploid strain (Zimmermann et al., 1975), which permits simultaneous study of point mutations (*ilv1-92*→ Ilv^+), mitotic crossing over (*ade2*→Ade^+) and mitotic gene conversion (*trp5*→Trp^+). In our previous study, this test successfully detected prokaryotic antimutagens and their effect on recombination (Vuković – Gačić et al., 2001).

In this work we examined the potential of EO and linalool to modulate DNA repair and replication processes, by studying their antimutagenic effect against spontaneous and UV-induced mutagenesis in *E. coli* K12 and *S. cerevisiae* D7 assays (Vuković – Gačić and Simić, 1993; Simić et al., 1994, 1997, 1998; Knežević – Vukčević, 1995; Zimmermann et al., 1975). We used UV-irradiation (254 nm) as a mutagen for several reasons: (i) it mainly induces base substitutions which can be detected in the assays; (ii) it shares cellular mechanisms of mutation avoidance (nucleotide excision and post-replication recombination repair) and mutation fixation (translesion error-prone replication) with many chemical mutagens and carcinogens; (iii) there is no chemical interaction between mutagen and antimutagen, which is essential for detection of antimutagens with modulating effects on DNA replication and repair.

MATERIALS AND METHODS

Tester strains

The tester strains used in this study are listed in Table 1.

Preparation of essential oil of basil

Basil *(Ocimum basilicum* L.) was cultivated in the experimental field of the "Dr Josif Pančic" Institute for Medicinal Plant Research. This field is located in Pančevo, Serbia. Essential oil was prepared according to Ph. Jug. IV, by distillation of dried aerial parts (*Basilicii herba*) in a 2-m^3 steam distiller (Hromil) for 2 hours at a pressure of 3-4 bars and temperature of 135-145°C. The composition of essential oil was determined using analytical GC/FID and GC/MS techniques and the Wiley/NBS library of mass spectra (**Marinković et al., 2002); it is shown in** Table 2. The quality of essential oil meets standards Ph. Jug. IV and ISO 9909. Essential oil was stored at 4°C. Stock solutions of EO of basil and linalool (CAS No. 78-70-6, Sigma-Aldrich, Steinheim, Germany) were freshly dissolved in 96% ethanol (1:9).

Media and growth conditions

All bacterial strains were grown overnight at 37°C in LB medium (5 g NaCl, 10 g bacto tryptone, 5 g yeast extract, 1000 ml distilled water). *S. cerevisiae* D7 was grown in YPD medium (10 g yeast

Table 1. Tester strains.

	Strain	Relevant genotype	References/source
E. coli K12	SY252	*argE3*	Knežević and Simić, 1982
	IB103	as SY252 but *mutS215::Tn10*	Simić et al., 1998
	IB105	as SY252 but *uvrA::Tn10*	Simić et al., 1998
	IB111	as SY252 but PhO^C [*λp(sfiA::lacZ)*cI*Ind*]	Vuković-Gačić et al., 2006
	GY7066	*lacMS286*φ80dII*lacBK1ΔrecA306srl::Tn10*	*Dutreix* et al., 1989
	GY8281	as GY7066/mini-F*recA*$^+$	*Dutreix* et al., 1989
	GY8252	as GY7066/mini-F*recA730*	*Dutreix* et al., 1989
S. cerevisiae	D7	*ade2-40/119 trp5-12/27 ilv1-92/92*	Zimmermann et al., 1975

extract, 20 g bacto peptone, 20 g dextrose, 1000 ml distilled water) at 30°C with aeration. All media for the *S. cerevisiae* reversion assay were as described by Zimmerman n et al. (1975). The semi-enriched minimal medium (SEM) for *E. coli* K12 reversion assays (Tests A and B) was minimal agar medium supplemented with 3 % (v/v) nutrient broth (NB) (Witkin, 1976).

Ultraviolet irradiation

UV-irradiation was carried out with a germicidal lamp (from Camag) having maximum output at 254 nm (UV-C). Dose rates were measured with the Latarjet dosimeter (Latarjet et al., 1953). Cell suspensions in 0.01 M $MgSO_4$ were irradiated in glass Petri dishes at a thickness of less than 1 mm. Only in Test D were bacteria irradiated on plates. Cell suspensions and plates were kept in the dark to prevent photoreactivation.

Detection of antimutagenic potential against spontaneous and UV-induced mutagenesis (Tests A and B)

Overnight cultures of *E. coli* strains SY252, IB103 (*mutS*) and IB105 (*uvrA*) were washed by centrifugation and resuspended in 0.01 M $MgSO_4$. Cell suspensions of the SY252 and IB105 strains were irradiated with UV-doses of 28 J/m^2 and 3 J/m^2, respectively. Samples (0.1 ml) of unirradiated and UV-irradiated cells, appropriately diluted for determination of cell survival and Arg$^+$ revertants, were spread in duplicate onto 3% SEM plates with different concentrations of EO or linalool and incubated at 37°C for 48 h. Ethanol was used as a negative control.

Detection of effect on SOS induction and general protein synthesis (Test C)

The exponential culture of *E. coli* strain IB111 was washed by centrifugation, resuspended in 0.01 M $MgSO_4$,and irradiated with 10 J/m^2. The cells were incubated for 20 minutes in LB medium with and without EO or linalool, washed by centrifugation, resuspended in minimal medium supplemented with 10% casamino acids, and incubated for 20 minutes on ice. Following incubation, optical density OD_{600} was measured, the samples were diluted in appropriate buffer, and cells were lyzed. The mixture was incubated at 28°C for 5 minutes, and the enzymatic reaction was started by adding appropriate substrates for enzymes (2-nitrophenyl-β-D-galactopyranoside CAS No. 73660, Fluka Sigma-Aldrich, Steinheim, Germany; and p-nitrophenyl phosphate, CAS No. 104-0, Sigma-Aldrich, Steinheim, Germany). The concentration of β-galactosidase and alkaline phosphatase was determined as described by Quillard and Hofnung (1993).

Detection of effect on intrachromosomal recombination (Test D)

Intrachromosomal recombination was measured in *E. coli* strains GY8281 (*recA*$^+$) and GY8252 (*recA730*) by monitoring Lac$^+$ recombinants on MacConkey lactose plates (Konrad, 1977) with or without EO or linalool. Samples (0.01 ml) of bacterial exponential cultures (3 x 10^8 cells/ml) were spread in the form of patches (2 x 2 cm) in triplicate on the same plate and irradiated with split UV-doses (5+5 J/m^2 for *recA*$^+$; 1+1 J/m^2 for *recA730*). The first UV exposure was immediately after plating and the second after 3 h of incubation at 37°C. The number

Table 2. Chemical composition of essential oil of basil (%).

Monoterpenes		**Sesquiterpenes**	
α-Terpinene	0.005	β-Burbonene	0.080
Camphene	0.006	α-Murolene	0.090
α-Pinene	0.100	Naphthalene	0.270
β- Myrcene	0.300	α-Copaen	0.400
Limonene	0.900	α-Humulene	0.500
Monoterpenoids		β-Caryophyllene	0.560
p-Cimen-8-ol	0.025	Zingiberene	0.600
Terpinen-4-ol	0.040	β-Elemene	0.800
Carvone	0.060	α-Bergamotene	1.020
trans-β-Ocimene	0.100	β- Selinene	1.040
endo-Borneol	0.270	α-Guaiene	1.110
endo-Bornylacetate	0.300	δ-Cadinene	1.130
Camphor	0.300	α-Selinene	1.670
Nerol	0.400	δ-Guaiene	2.100
cis-β-Ocimene	0.400	γ-Cadinene	2.500
α-Terpinolene	0.400	**Sesquiterpenoids**	
Thiogeraniol	0.560	Nerodiol	0.110
α-Terpineol	0.700	cis-Farnesol	0.180
1,8-Cineole	0.800	trans-Murolol	0.430
Geraniol	1.900	α-Cadinol	2.560
Linalool	69.200		
Aromatic compounds			
Eugenol	1.400		
Estragole	2.400	**Identified in total**	97.716 %

of Lac$^+$ papillae was determined after incubation at 37°C for 48 h. Strain GY7066 (Δ*recA*), which formed no papillae, was used as a negative control in all experiments.

Determination of bacterial growth rate

Overnight cultures of repair-proficient strain SY252 and excision repair deficient mutant IB105 were diluted 50 fold in fresh LB medium, with or without EO or linalool, and incubated at 37°C with aeration. Samples were taken every 30 min and optical density OD_{600} was measured using a Shimadzu UV/VIS-120-02 spectrophotometer.

S. cerevisiae D7 assay

The exponential culture containing about 3 x 10^7 cells/ml was washed by centrifugation and resuspended in sterile distilled water. The cell suspension was irradiated with a UV-dose of 130 J/m^2. Samples (0.1 ml) of unirradiated and UV-irradiated cells, appropriately diluted for determination of cell survival and Ade$^+$ recombinants, and undiluted for determination of Ilv$^+$ and Trp$^+$ cells, were spread in duplicate onto plates with different concentrations

Table 3. Effect of basil derivatives on intrachromosomal recombination in *E. coli*.

Strain	UV doses (J/m^2)	EO (µl/plate)					
		0	Ethanol	20	%S	30	%S
recA$^+$	0	282±11	229±15	144±10*	**-37**	174±12*	**-24**
	10	329±7	350±22	248±4*	**-29**	282±20	**-19**
recA730	0	182±16	85±6	197±14*	**132**	92±4	**8**
	2	238±19	194±24	360±4*	**85**	227±21	**16**
		Linalool (µl/plate)					
		0	Ethanol	10	%S	20	%S
recA$^+$	0	282±11	229±15	191±14	**-17**	213±12	**-7**
	10	329±7	350±22	287±13*	**-18**	284±16*	**-19**
recA730	0	182±16	85±6	153±23*	**80**	236±17*	**177**
	2	238±19	194±24	287±26*	**48**	208±6	**7**

*p<0.05 compared with corresponding samples without substances.

of EO or linalool. Cell survival and Ade$^+$ recombinants were determined on YPD plates. Ilv$^+$ revertants and Trp$^+$ convertants were scored on minimal plates supplemented with tryptophan or isoleucine, respectively. Plates were incubated at 30°C for 72 h. Ethanol was used as a negative control.

Statistical analysis

The Student's *t*-test was employed for statistical analysis. Significance was tested at the p<0.05 level. The results presented in figures and tables are expressed as the means obtained from three independent experiments, with the standard error of the mean. In all applied tests, we calculated the percentage of inhibition of mutagenesis (% I) as described by W a l l et al. (1988).

RESULTS

Antimutagenic potential of EO and linalool against spontaneous and UV-induced mutagenesis in Escherichia coli

In order to investigate the possible role of DNA repair pathways in the antimutagenic effect of EO of basil and linalool, we investigated their effect on spontaneous and UV-induced mutagenesis. Spontaneous mutagenesis was examined in repair-proficient, nucleotide excision repair-deficient (*uvrA*), and MMR-deficient (*mutS*) strains. The applied concentrations of both basil derivatives (up to 20 µl/plate) were not toxic and had no effect on spontaneous mutagenesis in any of the tested strains (data not shown).

The effect of basil derivatives on survival and UV-induced mutagenesis is shown in Fig. 1. In the range of applied concentrations, both EO and linalool exhibited caused reduction of UV-induced mutagenesis in the repair-proficient strain (Figs. 1a, 1b). Maximum reduction, 32% for EO and 51% for linalool, was achieved at a concentration of 20 µl/ plate, with more than 80% surviving cells. At all tested concentrations, linalool exhibited a stronger antimutagenic effect in comparison with EO. In the nucleotide excision repair-deficient strain, neither derivative had any effect on UV-induced mutagenesis (Figs. 1c, d).

Effects of EO and linalool on SOS induction in Escherichia coli

The effects of EO and linalool on the level of SOS induction, corresponding to the induction of mutagenic SOS repair, were monitored in repair-proficient strain IB111. In this strain, expression of the *lacZ* gene, coding for the enzyme β-galactosidase, is placed under control of the *sfiA* gene. Since *sfiA* is one of the SOS genes, the level of β-galactosidase will reflect the level of SOS induction. The non-specific effects of EO and linalool on general protein synthesis were determined by measuring the enzyme alkaline phosphatase, which is constitutively

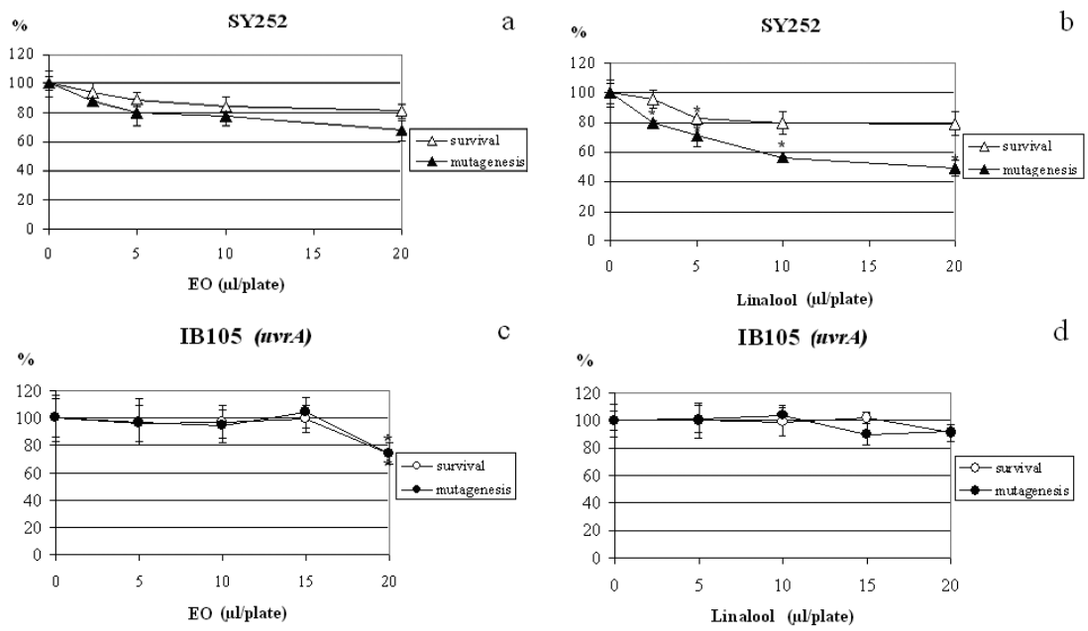

Fig. 1. Effects of EO and linalool on survival (open symbols) and UV-induced mutagenesis (closed symbols) in strains SY252 and IB105 of the *E. coli* K12 assay system. UV-doses: 28 J/m2 for SY252 and 3 J/m2 for IB105. Number of UV-induced revertants: SY252 278±15; IB105 540±50. *p<0.05 compared with corresponding samples without substances.

expressed in this strain.

The applied concentration of EO and linalool (0.7 µl/ml, showing the highest antimutagenic response in the repair-proficient strain) decreased the amount of UV-induced β-galactosidase, by 13 and 30%, respectively (Fig. 2). However, there was similar inhibition of alkaline phosphatase, 10% for EO and 27% for linalool, indicating that the obtained effect on β-galactosidase synthesis is non-specific.

Effects of EO and Linalool on intrachromosomal recombination in Escherichia coli

The effects on homologous recombination were measured using strains with two non-overlapping deletions in the duplicated *lac* operon, in which intrachromosomal recombination results in the formation of Lac$^+$ recombinants. The strains carry different *recA* alleles and thus have different capacities for both recombination and SOS induction. In the *recA*$^+$ strain, with a functional *recA* gene, there is significant inhibition of intrachromosomal recombination in the presence of EO, both in unirradiated (37% and 24%) and UV-irradiated (29%) sample (Table 3). In comparison with EO, a weaker inhibitory effect is obtained with linalool. In the *recA730* strain, which constitutively possesses a high level of activated RecA protein, significant stimulation of recombination is detected in the presence of both basil derivatives. The maximum stimulation of recombination by EO was 132% in unirradiated and 85% in UV-irradiated samples, while linalool showed maximum stimulation of 177% in unirradiated and 48% in UV-irradiated samples. The obtained results show that basil derivatives inhibit intrachromosomal recombination in the *recA*$^+$ strain, but stimulate recombination in the *recA730* mutant.

Effect of EO and linalool on bacterial growth rate

To check whether the reduction of UV-induced mutagenesis results from selective inhibition of growth of the repair-proficient strain, we compared the growth rates of repair-proficient SY252 and excision repair-deficient IB105 cells in the presence of EO or linalool. In both strains, there was similar inhibition of cell growth during 300 min of incubation with EO or linalool (Fig. 3).

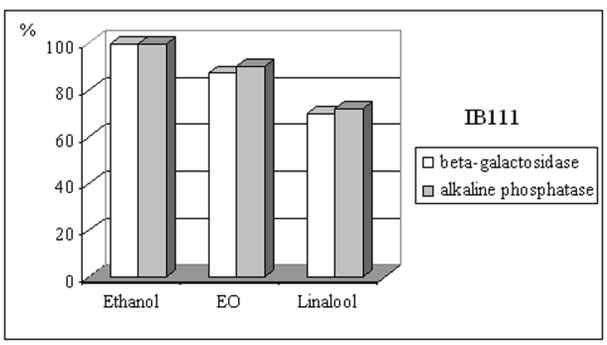

Fig. 2. Effects of basil derivatives on SOS induction (β-galactosidase) and protein synthesis (alkaline phosphatase) in repair proficient strain IB111 of *E. coli* K12 after UV-irradiation (10 J/m2)

Effect of EO and linalool in the Saccharomyces cerevisiae D7 assay

Investigation of spontaneous and UV-induced mutagenesis in *S. cerevisiae* D7 showed no significant changes in the number of Ilv^+ revertants caused by EO or Linalool (Fig. 4). Although the applied concentrations (2.5, 5 and 7.5 µl/ plate) were not toxic to *S. cerevisiae* D7 cells, as determined by monitoring colony counts on YPD plates, there was a dose dependant increase in the proportion of small colonies in both unirradiated and UV-irradiated samples, indicating slower growth in the presence of basil deriv-

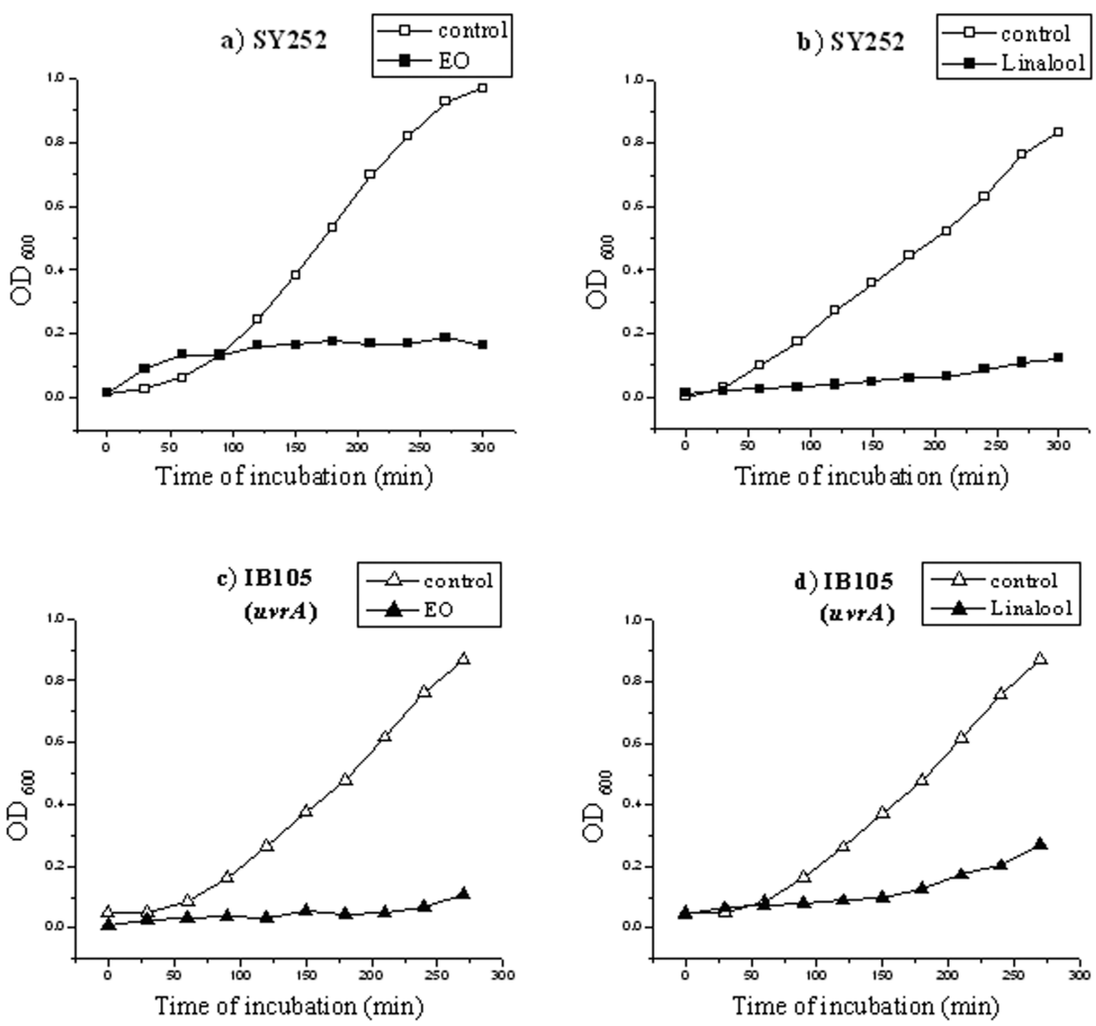

Fig. 3. Effects of EO and linalool on growth rate of *E. coli* K12 strains. EO 1 µl/ml for SY252, 0.5 µl/ml for IB105; linalool: 0.7 µl/ml for SY252, 0.3 µl/ml for IB105.

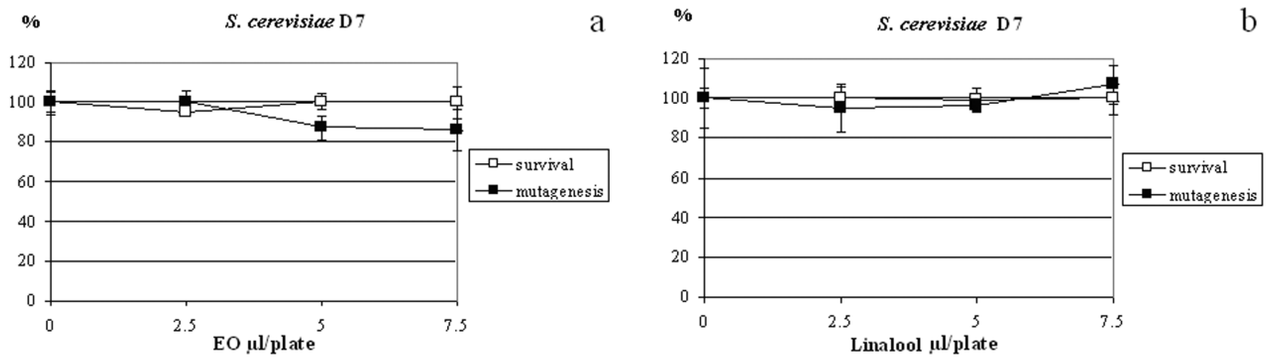

Fig. 4. Effects of EO and linalool on survival (open symbols) and UV-induced mutagenesis (closed symbols) in *S. cerevisiae* D7. UV-dose 130 J/m2. Number of UV-induced revertants: 130±25.

atives. The number of pigmented twin-spot colonies, resulting from UV-induced mitotic crossing over at the *ade2* locus, decreased 2-3 times relative to the control, while mitotic gene conversion was not affected (data not shown).

DISCUSSION

DNA repair is a dynamic process and can be modulated by many factors, such as the rate of DNA replication and cell proliferation, the level of expression of certain genes, inactivation of certain repair enzymes, etc. Protective effect of antimutagens following DNA damage can be obtained mainly through increase in the fidelity of DNA replication, stimulation of error-free repair of DNA damage, and inhibition of error-prone repair systems (K a d a et al., 1985). In the present work, we examined the antimutagenic effects of basil derivatives (EO and linalool) against UV-induced mutations and participation of different mechanisms in antimutagenesis.

In the *E. coli* K12 assay system, EO and linalool inhibited UV-induced mutagenesis in a repair-proficient strain, but had no effect on spontaneous mutagenesis in repair-proficient, nucleotide excision repair-deficient, and MMR-deficient strains. These results indicate that both basil derivatives have an antimutagenic potential that is independent of the MMR pathway and modulation of DNA replication.

Although EO and linalool had a similar inhibitory effect on the growth of repair proficient and nucleotide excision repair deficient cells (Fig. 3), an antimutagenic effect against UV-induced mutagenesis is detected only in the repair-proficient strain (Fig. 1). We propose that by arresting bacterial growth and cell division, basil derivatives increase the chances that DNA lesions will be repaired by nucleotide excision repair in an error free manner before the next division takes place.

The results obtained in other tests are consistent with this idea. As clearly shown in Test C, the reduction of SOS induction by basil derivatives is non-specific, caused by general inhibition of protein synthesis (Fig. 2). Increased recombination following DNA damage is also ruled out as a mechanism because both derivatives inhibited recombination in the UV-irradiated *recA*$^+$ strain (Test D, Table 3). Our speculation that this effect is caused by inhibition of RecA protein amplification is supported by increased recombination in the *recA730* mutant, with high constitutive levels of RecA protein.

The observed reduction in the size of colonies and number of Ade$^+$ recombinants in *S. cerevisiae* D7 by basil derivatives could also be caused by inhibition of protein synthesis, leading to reduced growth of the yeast population. In addition, published data suggest that essential oils in yeast induce damage to mitochondrial membranes resulting in liberation of ROS, oxidative stress, and cell death (B a k k a l i et al., 2005). Considering that liberation of ROS leads to increased incidence of oxidative DNA damage and that both UV photoproducts and oxidatively damaged DNA bases are removed by nucleotide excision repair (G e l l o n et al., 2001), saturation of the repair mechanism might account for the lack of antimutagenic effects of EO and linalool against

UV-induced mutagenesis in *S. cerevisiae*.

In conclusion, our present work and previous studies (N i k o l i ć, 2004; S t a n o j e v i ć et al., 2004, 2006) show that EO of basil and linalool exhibit an antimutagenic potential against UV- and *t*-BOOH-induced mutagenesis in bacteria. The mechanisms involved include inhibition of protein synthesis and cell proliferation and consequently increased efficiency of nucleotide excision repair, as well as inhibition of oxidative DNA damage. On the contrary, the protective effects of EO and linalool in yeast are restricted to oxidative mutagens. In higher eukaryotes, *Ocimum* species induce antioxidative enzymes (glutathione reductase, superoxide dismutase, catalase), reduce lipid peroxidation, increase Phase II enzyme activity associated with detoxification of xenobiotics, inhibit carcinogen-activating Phase I enzymes, protect against ionizing radiation effects, and reduce tumor incidence (D a s g u p t a et al., 2004). The described effects show the need for further evaluation of the protective potential of basil and its derivatives.

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ЕФЕКАТ ЕТАРСКОГ УЉА БОСИЉКА (*OCIMUM BASILICUM* L.) НА UV-ИНДУКОВАНУ МУТАГЕНЕЗУ КОД *ESCHERICHIA COLI* И *SACCHAROMYCES CEREVISIAE*

ЈАСНА СТАНОЈЕВИЋ, ТАЊА БЕРИЋ, БИЉАНА ОПАЧИЋ, БРАНКА ВУКОВИЋ-ГАЧИЋ, ДРАГА СИМИЋ И ЈЕЛЕНА КНЕЖЕВИЋ-ВУКЧЕВИЋ

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Антимутагени потенцијал етарског уља (EO) босиљка и његовог главног састојка линалола је изучаван помоћу *E. coli* K12 и *S. cerevisiae* D7 тестова. У *E. coli* K12 тесту EO и линалол су инхибирали UV-индуковану мутагенезу у репарационо способном соју, док није било спонтане мутагенезе у репарационо способном соју и мутантима дефектним у ексцизији и репарацији погрешно спарених база. Закључено је да се редукција UV-индуковане мутагенезе одвија смањењем синтезе протеина и брзине ћелијских деоба, што доводи до повећања ефикасности ексцизионе репарације.