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Original article

The protective effects of epigallocatechin-3- gallate (EGCG) on hydrogen peroxide-induced oxidative damages in *Saccharomyces cerevisiae*

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Summary. Epigallocatechin gallate (EGCG), one of the green tea ingredients, is a non-toxic catechin derivative and is an effective polyphenol in preventing tissue damage, cancer formation and increasing metabolic rate. Strong antioxidant property EGCG having anti-inflammatory, antioxidant, antihypertensive, antimicrobial, antiviral, antifungal, antitumor and various organs as well as neuroprotective effect of many convenience protection against ischemia-reperfusion injury. In this study, four groups were formed to investigate whether Epigallocatechin-3-gallate (EGCG) has a protective role against the damage caused by hydrogen peroxide (H_2O_2) in *Saccharomyces cerevisiae*. Groups: (i) Control Group; Yeast cultivated group only; (ii) EGCG Group: EGCG administered group (10 %); (iii) H_2O_2 Group: Group given H_2O_2 (15 mM); (iv) EGCG + H_2O_2 (15 mM) Group: Group given EGCG (10 %) + H_2O_2 (15 mM). *S. cerevisiae* cultures were developed at 30 °C for 1, 3, 5 and 24 hours (h). Cell growth, lipid peroxidation MDA (malondialdehyde) analysis and GSH (glutathione) levels were determined by spectrophotometer. Total protein changes were detected by SDS-PAGE electrophoresis and calculated by Bradford method. According to the results obtained, Cell growth (1, 3, 5 and 24 h), total protein synthesis and GSH levels (24 h) increased in EGCG groups, while MDA level decreased (24 h) when compared with H_2O_2 group. As a result, EGCG has been shown to have an effect that promotes cell growth and total protein synthesis as well as reducing oxidative damage in *S. cerevisiae* culture.

Keywords: EGCG, H_2O_2 ,oxidative damage, protein, *Saccharomyces cerevisiae*, SDS-PAGE

Introduction

Antioxidants are important in reducing the risk of people suffering from various diseases or in the treatment of individuals suffering from these diseases. Antioxidants, which are important for human health and are found in many plants, react with free radicals and prevent damage to cells. Polyphenols are one of these antioxidants and their natural sources are fruit, tea and coffee. Epigallocatechin-3 gallate (EGCG), which is the most active component of catechins in tea, has a very important role in ensuring DNA stability and in healthy life [1]. Today, the second most popular beverage after water consumption, tea is obtained from the green tea plant (*Camellia sinensis* L.) originating in southwest China and northeast India. Green tea is an evergreen plant and it wants abundant rain and for it the temperature should be sufficient in the growing area [2]. Green tea contains 80% polyphenols and flavonoids. Polyphenols are cyclic organic compounds carrying hydroxyl or carboxyl groups in their structure. Thus, they easily capture and neutralize free radicals [3]. Apart from catechins, green tea also contains a lot of soluble substances such as caffeine, theanine, chlorophyll, organic acids and vitamins [4]. In recent years, it has been reported that green tea

polyphenols have antioxidant, antiinflammatory, anticarcinogenic, probiotic and antimicrobial properties and prevent lipid accumulation by protecting the cell from autophagy under stress conditions. In addition, endothelial dysfunction prevents cancer by preventing cardiovascular diseases, ischemia-reperfusion damage, tumor development and metastasis of cancer cells [3, 5, 6]. Recent studies have indicated that EGCG provides extensive antiviral protection against the virus. The maturation, proliferation, infectiousness and infectiousness of EGCG, including adenovirus, coronavirus, influenza virus, rotavirus, herpes simplex virus (HSV), enterovirus (poliovirus, hepatitis A virus) and human immunodeficiency virus (HIV), alpha virus and function is inhibited was determined. Antiviral activities of EGCG trigger the mechanisms of acting as an antioxidant, inhibiting enzymes, suppressing viral RNA synthesis, disrupting cell membranes, preventing penetration into receptor cells by binding to virulent proteins [7]. Experimental analysis show that EGCG prevent growth and increase apoptosis in various cancer cells such as leukemia, melanoma, prostate cancer, stomach cancer, skin cancer, breast cancer, lung cancer and colon cancer [8].

S. cerevisiae is a widely used microorganism in beer and bread making. *S. cerevisiae* are unicellular eukaryotic microorganisms found in the Ascomycota branch. Like complex eukaryotes, the chromosomes of the yeast strain of *S. cerevisiae* are also bound by histones and are located in the nucleus. The yeast genome contains 16 chromosomes and these chromosomes are reproduced from more than one origin during the S phase. It also contains 14 megabas double genomic DNA and about 6000 genes. When comparing all the potential protein coding genes of yeasts and mammalian protein sequences, it is known that there is a statistically about 31% similarity between them. Unlike high-build eukaryotes, *S. cerevisiae* grows fast, genes can be manipulated easily and cheaply. Thanks to these features, it provides an inexpensive, flexible and fast genetic system to investigate the events occurring in the cell. This greatly facilitates genetic analysis. Therefore, *S. cerevisiae* is used as a model organism to understand the molecular basis of eukaryotic cell functions [9, 10, 11].

The aim of this work was to investigate the protective effects of EGCG against H_2O_2-induced oxidative damage in *S. cerevisiae.*

Materials and Methods

Research groups

In this work, 4 groups were formed. Groups: (i) Control Group: Yeast cultivated group only; (ii) EGCG Group: EGCG administered group (10 %); (iii) H_2O_2 Group: Group given H_2O_2 (15 mM); (iv) EGCG + H_2O_2 (15 mM) Group: Group given EGCG (10 %) + H_2O_2 (15 mM). Immediately after sterilization, EGCG (10 %) and H_2O_2 (15 mM) were added to *S. cerevisiae* cultures and the cultures were developed at 30 °C for 1 h, 3 h, 5 h, and 24 h (overnight). Development environment of *S. cerevisiae*: YEPD (for 50 ml; 1.5 g yeast extract, 1.5 g tripton, 1.5 g glucose) were prepared for the development and reproduction of yeasts. Then, 5 flasks were taken and 50 ml of 250 ml of prepared medium was added to each flask. After standing at the autoclave for 1 hour at 121 °C, it was removed and cooled. In addition to the burner flame, 800 µl of yeast was planted in each flask. After waiting 20 minutes in the oven, blind measurement was made. For the preparation of 10% EGCG; 10 g EGCG sample dissolved in 100 ml distilled water. Then H_2O_2 and EGCG were added to the other flasks removed from the oven besides burner flame. It was developed at 30 °C by adding 1 ml of EGCG and 300 µl of H_2O_2 according to the content of the groups [11, 12].

Application of egcg and H_2O_2 chemical to S. cerevisiae cell culture

For the preparation of 10% EGCG; 10 g EGCG sample dissolved in 100 ml distilled water. After, EGCG applied to the EGCG and EGCG + H_2O_2 groups at 10%. H_2O_2 supplemented to the H_2O_2 and EGCG + H_2O_2 groups at 15 mM. After this step, *S. cerevisiae* medium developed at 30 °C. For next analysis [11].

S. cerevisiae cell development measurements

Culture samples were developed at 30 °C for 1, 3, 5 and 24 hours (overnight) and measured using a spectrophotometer at 600 nm [11, 12].

SDS-PAGE (sodium dodecyl sulfate-polyacrylamide gel electrophoresis) analysis

Samples of *S. cerevisiae* cultures were prepared for SDS-PAGE. Protein samples were then analyzed by SDS PAGE. Gel bands were obtained and protein bands were examined between the groups [12, 13, 14].

S. cerevisiae Malondialdehyde (MDA) analysis

In the malondialdehyde analysis, the test tubes were taken and the sample was blinded. 0.5 ml of the supernatant was annexed and 1 ml of TBA were added to all of the test tubes. The test tubes were kept in a 90 °C water bath for 30 min. and 4 ml of n-butanol was added by cooling. Centrifugation was performed at 3000 rpm for 10 min. and the resulting supernatant to the sample tube and 0.5 ml of pured water was annexed to the blind tube. Subsequently, 2.5 ml of TCA layer was removed and transferred to a new test tube. The measurements were made in the spectrophotometer at 535 nm wavelength and the results were recorded as nmol/ml [15].

Glutathione (GSH) analysis

For GSH analysis; 0.4 ml of 10% cell homogenate and 0.2 ml of 20% TCA were mixed. The supernatant was removed by centrifugation at 3000 rpm for 15 min. For the blind sample, 0.2 ml of 150 mM KCl, 0.2 ml of the supernatant and 1 ml of 0.3 M Na_2HPO_4 were mixed. After waiting for 5 min., the absorbance of the yellow color was measured in spectrophotometer at 412 nm wavelength [16].

Total protein density (bradford) measurements

Total protein density was performed using a spectrophotometer at 595 nm (OD_{595}) according to the bradford method. Using different concentrations of BSA protein, BSA protein standards were prepared and the total amount of protein in *S. cerevisiae* groups corresponding to this standard value was calculated [11, 17].

Statistical analysis

The data obtained from this experimental study were evaluated with the SPSS 22 package program. One Way Anova *Post Hoc* LSD tests were used to determine the differences within the group and the measurements were repeated 3 times for the reliability of the statistical analysis.

Results

S. cerevisiae cell development measurement results

According to Table 1 and Figure 1A, there is a significant difference between the groups with different development times ($p < 0.05$). EGCG increased cell growth in EGCG and EGCG + H_2O_2 groups in comparison to the H_2O_2 damage group.

Total protein density (bradford) measurements

When the total protein results given in Table 2, 3, Figure 1B, Figure 1C and Figure 1D are examined, we can say that EGCG promotes protein synthesis in *S. cerevisiae*. Especially when compared with H_2O_2 group, it is seen that the protein synthesis increased at a high rate in the EGCG + H_2O_2 group.

S. cerevisiae Malondialdehyde (MDA) analysis results

Table 4, Figure 1E and Figure 1F reveals that the highest MDA levels were in H_2O_2 group and significantly decreased in EGCG + H_2O_2 group ($p < 0.05$).

Glutathione (GSH) analysis

When we examine the GSH levels given in Table 5 and Figure 1G, the lowest GSH level was in the H_2O_2 group and decreased significantly in EGCG + H_2O_2 group ($p < 0.05$).

Table 1. Cell development of *S. cerevisiae* EGCG at different times

Groups	1h	3h	5h	Overnight
Control	0.88 ± 0.02[c]	1.18 ± 0.02[c]	1.40 ± 0.02[c]	1.80 ± 0.02[c]
EGCG	1.54 ± 0.02[a]	1.68 ± 0.02[a]	1.83 ± 0.03[a]	2.05 ± 0.03[a]
H_2O_2	0.29 ± 0.02[d]	0.20 ± 0.02[d]	0.45 ± 0.02[d]	1.48 ± 0.02[d]
EGCG + H_2O_2	1.18 ± 0.02[b]	1.23 ± 0.02[b]	1.37 ± 0.02[b]	1.75 ± 0.03[b]

The difference between the groups with different letters **a,b,c,d is significant (p <0.05). One-Way ANOVA Post Hoc LSD Test

Table 2. Total protein densities of bradford pellet

Groups (pellet)	Total protein densities
Control	93.29 ± 0.02[a]
EGCG	95.35 ± 0.03[a]
H_2O_2	52.11 ± 0.03[c]
EGCG + H_2O_2	74.17 ± 0.02[b]

[a-c]The difference between the groups bearing the different letters in the columns is significant (p <0.05). One-Way ANOVA Post Hoc LSD Test

Table 3. Bradford supernatant total protein densities

Groups (supernatant)	Total protein densities
Control	5.38 ± 0.02[a]
EGCG	5.50 ± 0.02[a]
H_2O_2	1.52 ± 0.03[c]
EGCG + H_2O_2	3.58 ± 0.02[b]

[a-c]The difference between the groups bearing the different letters in the columns is significant (p <0.05). One-Way ANOVA Post Hoc LSD Test

Table 4. MDA levels

Groups	MDA level
Control	1.52 ± 0.02c
EGCG	1.46 ± 0.02c
H_2O_2	4.44 ± 0.02a
EGCG + H_2O_2	2.65 ± 0.02b

[a-c]The difference between the groups bearing the different letters in the columns is significant (p <0.05). One-Way ANOVA Post Hoc LSD Test

Table 5 GSH level (pellet)

Groups	GSH level (pellet)
Control	9.00 ± 0.02[a]
EGCG	95.60 ± 0.02[a]
H_2O_2	54.47 ± 0.02[c]
EGCG + H_2O_2	73.53 ± 0.03[b]

[a-c]The difference between the groups bearing the different letters in the columns is significant (p <0.05). One-Way ANOVA Post Hoc LSD Test

SDS-PAGE (sodium dodecyl sulfate-polyacrylamide gel electrophoresis) analysis

The SDS-PAGE gel image (Figure 2) show that the protein concentration was significantly increased in EGCG + H_2O_2 group when compared to the H_2O_2 group. As a result of this study, it was concluded that EGCG increases the development of *S. cerevisiae* despite the negative effects of H_2O_2.

Discussion

We foresee that the results of this experimental study will make important contributions to the existing literature. Green tea contains many compounds such as polyphenols, vitamins, theanine and minerals. EGCG is the polyphenol group that contains the most abundant green tea ingredients. Green tea (*C. sinensis* L.) has been shown to have a variety of biological activities, antioxidation, cardiovascular protection, antiobesity and anticancer effects. Recent clinical and research studies have concluded that green tea extract consumption helps to reduce the risk of cardiovascular disease by providing weight loss. Furthermore, EGCG

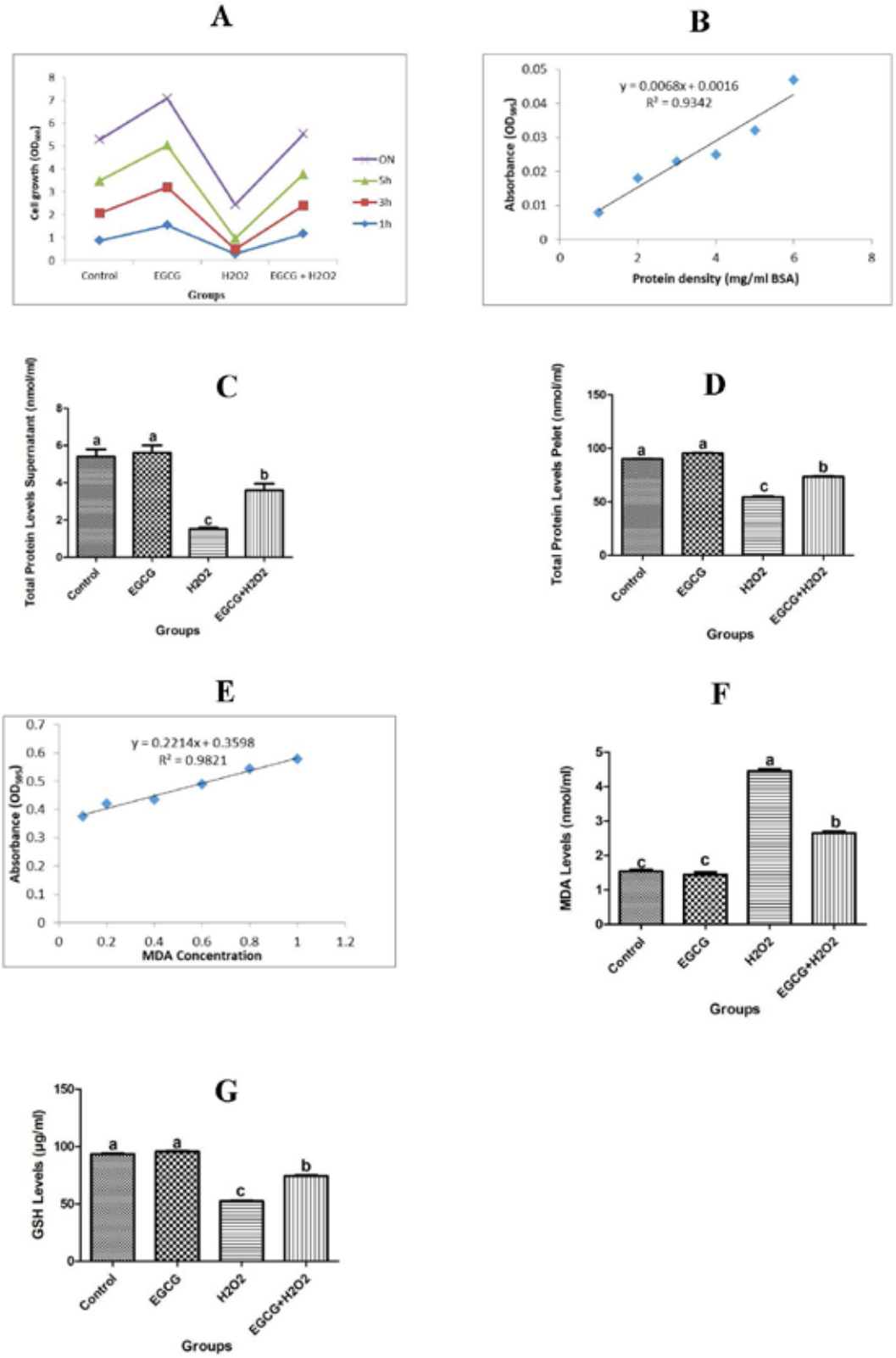

Figure 1A. Cell development of *S. cerevisiae* at different times. **Figure 1B.** Standard curve of bradford bovine serum albumin (BSA). **Figure 1C.** The supernatant total protein density among groups. **Figure 1D.** The pelet total protein density among groups. **Figure 1E.** MDA standard curve. **Figure 1F.** MDA level among groups. **Figure 1G.** GSH level among groups.

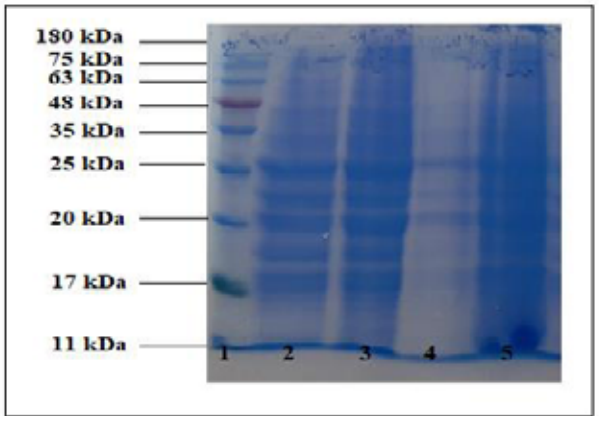

Figure 2. SDS-PAGE pellet protein bands. 1: Marker; 2: Control; 3: EGCG; 4: H_2O_2; 5: EGCG + H_2O_2

has been documented to be effective in preventing and treating many types of cancer. Regular consumption of green tea can reduce the risk of various types of cancer such as liver, lung, stomach, rectum, colon, pancreas and breast cancer. It has a strong antitumor and antimetastasis effect and is able to protect bone from bone destruction due to breast cancer [2, 18, 19]. Aslan et al. examined the preventive role of tomato against H_2O_2 induced damage in *S. cerevisiae* and they found that tomato has a protective feature due to its antioxidant properties. In this study; it was determined that EGCG, like tomato, has a protective feature in *S. cerevisiae* due to its antioxidant properties in line with the analyzes conducted [11]. Marques et al. investigated the protective effect of *Ginkgo biloba* leaf extracts in oxidative damage caused by H_2O_2 in *S.cerevisiae* and they stated that *Ginkgo biloba* leaf extracts stimulate the DNA protection mechanism by protecting DNA from oxidation. In this study; we have determined that EGCG has a strong protective effect against oxidative damage caused by H_2O_2 in *S. cerevisiae* [20].

Othman et al. investigated the potential protective effect of EGCG on type-2 diabetes-induced heart injury. They stated that CAT activities and GSH levels raised in EGCG treated groups. In this study, it was found that CAT activities and GSH levels increased in EGCG-treated groups thanks to the potential protective effect of EGCG [21]. Aslan emphasized that different juices and combinations have a protective role in reducing oxidative damage and increasing cell growth in *S. cerevisiae*. In line with the results of this study, EGCG has been found to have an effect of reducing oxidative stress [22]. Huang et al. examined the effect of EGCG in rats exposed to formaldehyde and they found that EGCG treatment reduced formaldehyde-induced neurotoxicity. In this study, it was determined that EGCG has a potential protective effect against damage caused by H_2O_2 in *S. cerevisiae* [23].

Zhao et al. stated that the main active ingredient of green tea polyphenols (GTPs), EGCG, has significant neuroprotective and neuro-restorative effects against various brain injuries, including some neuro degen-erative diseases [24]. Aslan indicated that mulberry extract increased cell growth by providing significant protection against H_2O_2 damage in *S. cerevisiae*. In this study, the results of this study, EGCG has been found to have an effect of reducing oxidative stress [25]. Gibbons et al. found that EGCG reduces micro-glia activation, oxidative stress, inflammation, and that catechins from green tea act as a general neuroprotective factor that helps prevent neurodegenerative diseases. According to the data obtained as a result of this study, it was determined that EGCG provides protection against oxidative stress by decreasing the MDA levels [26]. Lopez et al. stated that EGCG plays an important role in the regulation of adult hippocam-pal neurogenesis and maturation of dendrite. They also found that EGCG is highly effective in reducing oxidative stress in Alzheimer's disease. In our study; it was determined that EGCG provides a strong healing effect against the damage caused by decreasing MDA levels and increasing CAT and GSH levels thanks to its antioxidant properties [27].

Aslan et al. expressed that the grape seed reduces oxidative damage caused by H_2O_2 in *S. cerevisiae* and has a protective role on *S. cerevisiae* growth [11]. They also found that MDA levels increased in H_2O_2 groups. In our study; it was found that EGCG reduced MDA levels and eliminated the oxiative effect by increasing CAT and GSH levels. Gumuscu has investigated the possible protective effects of turmeric and epigallocatechin gallate (EGCG) against paclitaxel-induced oxidative stress in rats. He concluded that turmeric and EGCG are effective in protecting tissues and organs thanks to their strong antioxidant properties. In addition, GSH and CAT activity was significantly increased

in turmeric and EGCG treated groups, while MDA levels increased in paclitaxel-treated groups. In our study; it was determined that EGCG provides a strong healing effect against the damage caused by decreasing MDA levels and increasing CAT and GSH levels thanks to its antioxidant properties [2]. Zhang and Zhang emphasised that EGCG has a good effect on the prevention of rat nephrotic syndrome and chronic progression of glomerular diseases. As in these stud-ies, in our study, it was determined that EGCG has a potential protective effect against damage [28]. Zhu et al. stated that EGCG have hyperemic and kidney-protective effects and may have a potential value in the treatment of hyperuricemia [29].

Kiruthika and Padma searched the protective role of *Zea mays* leaf extracts in *S. cerevisiae* against oxidative stress due to H_2O_2 and they stated that *Zea mays* leaf extracts provide effective protection against oxidative stress. In our study, EGCG has been found to have an effect of reducing oxidative stress [30]. Shanmugam et al. found that EGCG treatment significantly improves wound healing quality and protects the lung against oxidative stress by signifi-cantly suppressing the proliferation of A549 cancer cells in human lungs [31]. Aslan et al. researched the protective rol of ellagic acid (EA) in rats with CCl_4 induced lung damage, they stated that caspase-3, Nrf-2 expression levels significantly reduced and COX-2, TNF-α, NF-κB and bcl-2 expression levels increased in CCl_4 groups compared to EA-treated groups ($p<0.05$) [32]. Kim et al. examined the effect of EGCG on keratinocytes (HaCaT cells) and they stated that EGCG provides protection against various external stimuli [33]. Ko et al. stated that EGCG has anti-proliferative and chemopreventive effects against various types of cancer such as colon, lung and breast cancer. In our study, it was determined that EGCG, which has anti-inflammatory and anti-oxidant effects, provides strong protection against the damage caused [34]. Huang et al. searched the effects of OLE1 on cadmium-induced oxidative stress in *S. cerevisiae* and they stated that OLE1 reduced the oxidative stress caused by cadmium. When we examine the data we obtained as a result of this study, it was concluded that, like OLE1, EGCG eliminated the oxidative stress in *S. cerevisae* [35].

Chen et al. reported that EGCG facilitates redox balance and glycolysis by alleviating ethanol-induced damage in the cell wall of *S. cerevisiae* [36]. Kaushal et al. investigated the antioxidant and genoprotective activity of EGCG against arsenic-induced oxidative stress in balc/C mice. They concluded that EGCG has free radical scavenging, antioxidant and genoprotective activity against arsenic toxicity. In our study; EGCG has been found to have an effect of reducing oxidative stress [37]. Chong et al. researched the effects of EGCG on DNA repair pathways in *S.cerevisiae* and they concluded that EGCG is highly effective in maintaining genome stability by activating DNA repair pathways [38]. Kose et al. stated that curcumin and EGCG treatment provide significant protection against iron-induced oxidative damage in pancreatic cells [39]. Colina et al. noted that EGCG has a protective effect on human erythrocytes (RBC) and membrane molecular models [40]. Karacaoglu et al. explored the protective effects of EGCG in rats caused by cerulein-induced pancreatic damage and they stated that EGCG has antioxidant properties. They also observed an increase in GSH levels in groups treated with EGCG compared to the cerulein treated group. According to the GSH results obtained in our study; it has been determined that EGCG provides highly effective protection against oxidative damage caused by H_2O_2 [41].

Beyaz et al. examined the protective impact of ginger against oxidative damage caused by H_2O_2 in *S. cerevisiae* and they concluded that ginger has a very strong therapeutic effect against oxidative stress. In addition, they found that MDA levels decreased and GSH levels increased significantly in ginger-treated groups compared to the H_2O_2 groups [42]. Gok et al. researched the protective impact of hawthorn fruit extract against H_2O_2 induced oxidative stress in *S. cerevisiae* and they stated that MDA levels decreased and GSH levels increased significantly in groups with hawthorn extract ($p<0.05$). In our study, it was determined that EGCG, which has antioxidant effects, provides strong protection against the damage caused. EGCG has been found to reduce MDA levels and provide strong protection against damage caused by increasing CAT and GSH levels [43]. Luo et al. examined the antiproliferation and antimigration effects of EGCG

against bladder cancer and they noted that EGCG is highly effective in inhibiting cancer cell proliferation and migration [19]. Aslan et al. researched the protective impact of EA against muscle damage caused by CCl_4 in rats, they stated that TNF-α, NF-κB, COX-2, bcl-2 protein expression, MDA levels reduced, Nrf-2, caspase-3 protein expression levels and GSH levels and catalase activities raised compared to the CCl_4 group. In line with the results obtained; it was determined that MDA levels decreased and GSH levels increased in groups treated with ECGC against the damage caused by H_2O_2 [44].

Shin et al. examined the anticancer effects of EGCG on head and neck cancer and they noted that EGCG has potential chemotherapeutic drug activity [45]. Stuart et al. studied the effectiveness of EGCG in breast and prostate cancer and tehy found that EGCG induces apoptosis in breast cancer and prostate cancer cells by controlling cell cycle progression [46]. Dhatwalia et al. explored the protective role of EGCG against benzo (a) pyrene-induced lung toxicity in rats and they reported EGCG increased GSH level and CAT activity in EGCG-treated groups. According to the results obtained in our study; it was determined that MDA levels decreased and GSH levels increased in the groups treated with ECGC. This shows us that EGCG is highly effective against oxidative stress and damage [47]. Saeed et al. examined the protective role of EGCG against doxorubicin (DOX) induced cardiotoxicity in rats and they found that EGCG protects against DOX-induced cardiomyopathy [48]. Li et al. investigated the effect of sodium hydrosulfide (NaHS), a hydrogen sulphide (H_2S) donor, on the heat tolerance of corn seedlings compared to the antioxidant system, and they found that GSH activity raised and MDA levels reduced significantly in the groups given H_2S. In line with the results obtained; it was determined that MDA levels decreased and GSH levels increased in groups treated with EGCG against damage caused by H_2O_2 in *S. cerevisae* [49].

Peng et al. researched the effects of EGCG on immune-mediated glomerulonephritis (GN) and they found that EGCG significantly reduced kidney failure [50]. Karakus examined the protective effects of EGCG in HCT116 colon carcinoma cells and she stated that EGCG provides protection by causing cancer cells to die. In our study, it was deter-mined that EGCG has a potential protective effect against damage [7]. Mitrica et al. explored the protective effects of EGCG against UV-A-induced oxidative stress in *S. cerevisiae* and they concluded that EGCG is a powerful cleaning of reactive oxygen species (ROS) [51]. Zbynovska et al. reported the antioxidant effect of epicatechin against damage caused by H_2O_2 in rabbits and they stated that GSH activity increased, MDA and ROS levels decreased significantly in epicatechin-treated groups. According to the results obtained in our study; it was determined that MDA levels decreased and GSH levels increased in the groups treated with ECGC. This shows us that EGCG is highly effective against oxidative stress and damage [52].

Aslan et al. examined the neuroprotective impact of EA towards brain damage caused by CCl_4 in rats. They found that Nrf-2, caspase-3 protein expression, GSH levels and catalase activities increased, while NF-κB, TNF-α, VEGF, bcl-2, COX-2 protein expression levels and MDA levels decreased in EA treated group. In line with the data obtained as a result of this study, it was determined that MDA levels decreased and GSH levels increased in the groups treated with ECGC. This shows us that EGCG is highly effective against oxida-tive stress and damage [53]. Zhu et al. examined that EGCG, an important component of green tea, inhibits the influenza virüs [54]. Weber et al. stated that EGCG provides strong protection against chikungunya virus (CHIKV), an alphavirus that spreads through insects in developing countries recently, causing chikungunya fever [55]. Oliveira et al. investigated that EGCG, a powerful antioxidant, is a strong inhibitor against HIV and HSV virus. According to our findings; EGCG has been found to have strong healing effects thanks to its high antioxidant content [56].

Conclusion

EGCG provides effective protection against oxidative stress and it has been concluded that this compound suppresses lipid peroxidation products by reducing oxidative stress. The results of this study reveals that EGCG promotes total protein synthesis and increases cell growth in *S. cerevisiae*. In addition, it was found that

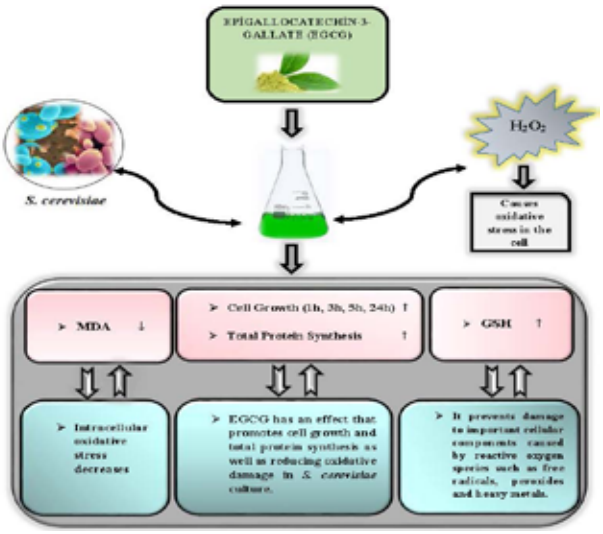

Figure 3. The effect of EGCG on *S. cerevisiae* cell growth, protein synthesis, GSH and MDA levels

GSH levels, cell growth, total protein density and protein synthesis raised but MDA levels reduced significantly in the EGCG-treated groups when compared to the H_2O_2 group (Figure 3). It is thought that the results of this study will contribute to the studies existing in the literature on the effect of EGCG on *S. cerevisiae* growth and guide future studies.

Conflicts of Interest

There are no conflicts of interests among the authors.

Acknowledgments

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