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RESEARCH ARTICLE

Investigation of Biological Properties of Acetone O-(4-chlorophenylsulfonyl)oxime and Acetone O-(2-naphthylsulfonyl)oxime

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ABSTRACT

The purpose of this study is to survey if acetone O-(4 chlorophenylsulfonyl) oxime (1a) and acetone O-(2-naphtylsülphonyl)oxime (2a) compounds have antimicrobial and antioxidant properties or not. For this purpose, the antioxidant activity of the compounds was tested using the DPPH free radical method and the method of determining the antibacterial activity of newly synthesized compounds. As a result, compound 1a shows better antioxidant activity than compound 2a at all tested concentrations. The antibacterial activities of sulfonate derivatives on Staphylococcus aureus, Pseudomonas aeruginosa Escherichia coli, and Enterococcus hirae strains were investigated and it was determined that all compounds showed partial antibacterial activity for S. aureus, E. coli, and K. pneumoniae strains.

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1. INTRODUCTION

Oximes are nitrogen-containing chemical compounds that occur in species representing kingdoms representing all life forms on earth [1]. After it has been determined that naturally synthesized oximes have high biological activity, chemically synthesized oximes are used for a number of different purposes, especially in the agricultural sector [2]. The literature review has shown that; Various sulfonate derivative oximes have antimicrobial, anticancer, antiviral, antihypertension, enzyme inhibition, antioxidant, heavy metal chelator, and antitubercular effects [3-14]. While these studies provide important information about the effects of sulfonate derivatives, they also emphasize the importance of sulfonate derivatives in many areas regarding the problems that human beings may face today and in the future.

The ability of antioxidants to capture free radicals makes them important in maintaining human health. Free radicals attack nucleic acid, proteins, lipids, and other oxidizable components of cells, initiating degenerative disease. The resulting anion compounds inhibit the oxidative mechanism that leads to degenerative diseases. For these reasons, antioxidant molecules with free radical scavenging properties play an important role as health-protective compounds [15]. According to Hazra et al. [16] determined by the DPPH method that fluorobenzopyrazoline derivative at 0.01 mm concentration has strong antioxidant properties. The results of another study by Su et al. [17] showed that sulfonate-containing myricetin derivatives can be considered as a new antibacterial reagent. While it has been shown that azomethine-bearing benzothiazole sulfonate derivatives have inhibitory effects on pancreatic lipase and tyrosinase enzymes, the interactions that occur in the active site of enzymes by the inhibition effect of sulfonate derivatives on enzymes have been demonstrated by molecular docking method [3]. Obesity, which is considered as one of the most important causes of many chronic diseases such as diabetes, hypertension, and cardiovascular diseases, is considered as one of the biggest threats to human health in our age [4]. The interaction of pancreatic lipase, which is the main enzyme responsible for the digestion of triacylglycerides, with other compounds has an important place in the prevention of obesity [19]. Tyrosinase, which has important functions in the production of melanin and hyperpigmentation of the skin and hair, is a copper-containing metalloenzyme that catalyzes the hydroxylation of L-tyrosine to L-DOPA and the oxidation of L-DOPA to dopaquinone reactions. Because of these features, tyrosinase is an important enzyme for the R&D units of cosmetic companies [20]. Acetylcholinesterase is an esterase that uses acetylcholine as a substrate. Butyrylcholinesterase is an esterase that uses butyrylcholine as a substrate. It also hydrolyzes xenobiotic compounds such as cocaine, succinylcholine, and aspirin [21]. In the advanced stages of Alzheimer's disease, which is one of the neurodegenerative diseases caused by a significant dysfunction in the cholinergic system, it is characterized by an increase in BuChE level and a decrease in AChE level [22]. In this situation, it is vital to develop substances that will interact selectively with BuChE and AChE.

Acetone O-(4-chlorophenylsulfonyl)oxime (1a) and Acetone O-(2-naphthylsulfonyl) oxime (2a) are easier for radicals to join the C = C double bond than the C = N or C = S bond. Because converting C=N or C=S bonds to C-N or C-S requires more energy than converting C=C to C-C. Thanks to the C=N, S=O, and C=C structures in (1a) and (2a) structures, it is possible for (1a) and (2a) to gain radical scavenging properties. In addition, it is predicted that increasing the stability of the electronegative -Cl group radicals in the molecular structure of (1a), will contribute to the trapping of the radicals in the structure and provide antioxidant properties to the molecules [23-25]. Su et al. [17] reported that the oxime ether derivative significantly affects the proliferation of SMMC-7721 liver cancer cells by preventing DNA replication. In the literature, there are not any findings on (1a) and (2a) compounds features to the antimicrobial and antioxidant. In the present study, the antioxidant and antibacterial activities of (1a) and (2a) sulfonate derivatives were determined.

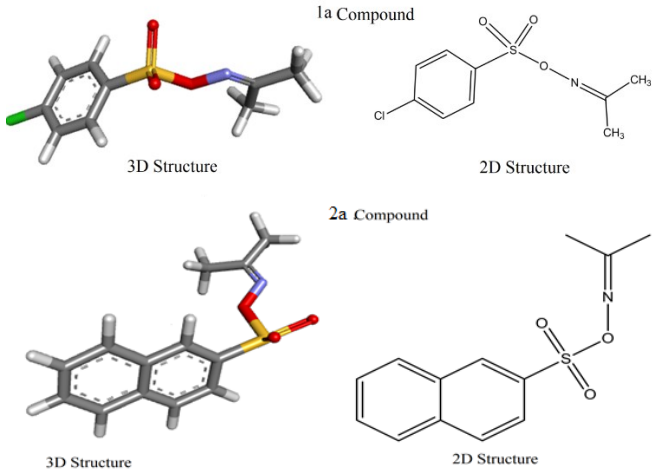

Figure 1. Structure of acetone O-(4-chlorophenylsulfonyl)oxime (1a) and Acetone O-(2-naphtylsülphonyl)oxime (2a) compounds

2. MATERIAL AND METHODS

2.1. Chemicals

DPPH, DMSO (Dimethyl sulfoxide) and Trolox were obtained from Sigma (Sigma-Aldrich GmbH, Sternheim, Germany). The blank antimicrobial test discs purchased from Oxoid (7.0 mm, Oxoid Ltd, Wade Road, Basingstoke, Hants, RG24 8PW, UK).

2.2. DPPH Radical Scavenging Activity

The antioxidant activity of the compounds was tested using the DPPH free radical method [26]. Solutions of the samples used as stock and were prepared at concentrations of 50 and 500 µg/ml. After adding 0.5 ml of the samples to be tested to 2.0 mL of DPPH solution dissolved in methanol, they were incubated at room temperature and in the dark for 30 minutes. The absorbance values of the solutions were measured spectrophotometrically at 517 nm. Trolox was used as the standard antioxidant.

2.3. Antibacterial Activity

The antibacterial activity of newly synthesized compounds was tested by the method of Tarhan et al. [27] *P. aeruginosa* (ATCC 9027) and *E. coli* (ATCC 10536) were used as Gram-negative bacteria and *E. hirae* (ATCC 10541) and *S. aureus* (ATCC 6538) were used as Gram-positive bacteria. Tetracycline (30 µg) was used as the positive control.

2.4. Statistical Analysis

Duncan Multiple Range Test was carried out using SPSS (v.17) to analyze the data obtained from the experiments, which was designed in repetitions. The statistical significance was set at $P \leq 0.05$ in all analyses.

3. RESULTS AND DISCUSSION

3.1. DPPH Radical Scavenging Activity

We can say that the main cause of damage to biological macromolecules is free radicals. One of the quick and simple ways to measure the antioxidant capacity of molecules is through DPPH radical quenching activity. Using the method, the free radical scavenging activities of natural and synthesized substances can be determined quickly and simply [28]. These molecules with antioxidant potential can be used in many areas [29]. As seen in Figure 2, the DPPH inhibitory activities of the tested compounds vary depending on concentration. It was determined that 1a showed better activity than 2a at all concentrations studied. It was measured that the concentration increase from 50 µg/ml to 500 µg/ml increased the antioxidant capacity from 8.8% to 42.8% for 1a and from 6.2% to 18.5% for 2a. Trolox used as standard was found to have higher cleaning activity than the compounds. In parallel with the current study, the antioxidant activity of the fluorobenzopyrazoline derivative, a sulfonated derivative, was tested by the DPPH method and it was determined that it had strong antioxidant activity at a concentration of 0.01 mm [16]. In a study conducted on corn, it was determined that substance 1a had positive effects in clearing H_2O_2 and alleviated the negative effects of stress by stimulating the antioxidant system [7].

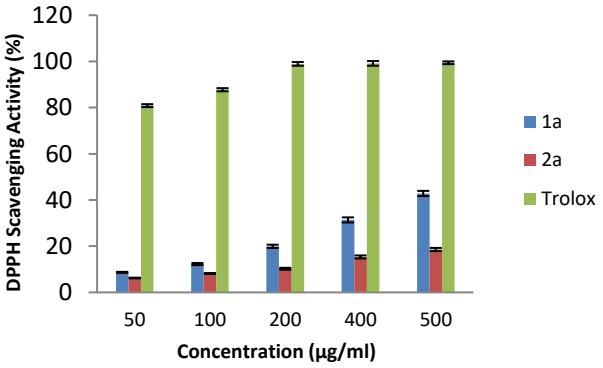

Figure 2. The effect of (1a) and (2a) compounds on antioxidant activity

3.2. Antibacterial Activity

The antimicrobial potential of the compounds was studied against four bacterial strains, two of them was Gram-positive and the others were Gram-nagative whether it shows activity or not. Of the two compounds, only **1a** showed weak antibacterial activity against *S. aureus* (8 mm zone of inhibition). Tetracycline, used as a standard antibiotic against the same bacterium, formed a 20 mm zone of inhibition. Both compounds tested showed no activity against other bacteria (Fig. 3). Mishra et al. [11] in their study; The antibacterial activities of sulfonate derivatives containing Shiff base on *S. aureus, P. aeruginosa, E. coli,* and *E. hirae* strains were investigated and it was determined that all compounds showed partial antibacterial activity for *S. aureus, E. coli* and *K. pneumoniae* strains.

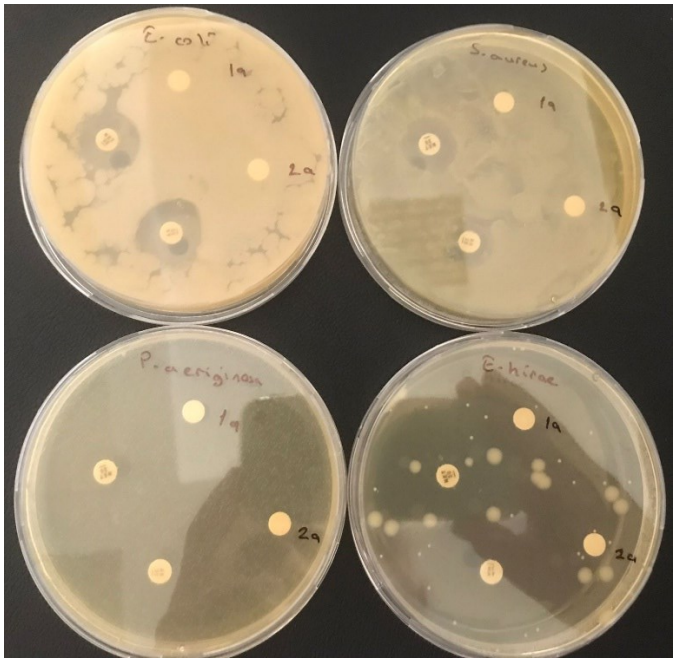

Figure 3. The effect of (1a) and (2a) compounds on antibacterial activity

According to the reports of the World Health Organization and many researchers, resistance to antibiotics that are naturally developed by bacteria or that arise as a result of the wrong and unconscious use of antibiotics in humans and animals seems to be a scourge for the whole world. An increasing number of diseases (such as pneumonia, tuberculosis, gonorrhea, salmonellosis) are becoming increasingly difficult to treat as the antibiotics that treat them are less effective. In addition, resistance to antibiotics increases the number of deaths, the length of hospital stays, and therefore the costs of medical care [30,31]. Oxidative stress and cancer caused by oxidative stress, it is undeniable that one of the important problems of today. Standard antioxidants and anticancer drugs that used against them have so many side effects and that phenomenon is still a big problem [32-34]. All these negativities we have mentioned have encouraged researchers to synthesize new nano molecules that have antimicrobial, anticancer, antioxidant properties, but have no or minimized side effects [27, 35].

In the light of the available findings, although the antioxidant properties of compounds (1a) and (2a) were seen to be quite low compared to trolox, it was determined that the antioxidant property of compound (1a) was significantly higher than that of compound (2a).

4. CONCLUSION

As a result, compound (1a) shows better antioxidant activity than compound (2a) at all tested concentrations. The antibacterial activities of sulfonate derivatives on *S. aureus, E. hirae, E. coli,* and *P. aeruginosa* strains were investigated and it was determined that all compounds showed partial antibacterial activity for *S. aureus, E. coli,* and *K. pneumoniae* strains. The activities exhibited in in vitro tests are at a weak level. More specific and targeted in vivo experimental studies are required to take advantage of the bioavailability properties of the compounds and to increase its bioactivity to higher levels.

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