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The FTIR Analysis of Some Macrofungus Extract-Antibiotic Interactions in Some Multi Drug Resistant (MDR) Bacterial Strains Having Active Efflux Pumps

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pharmaceuticals



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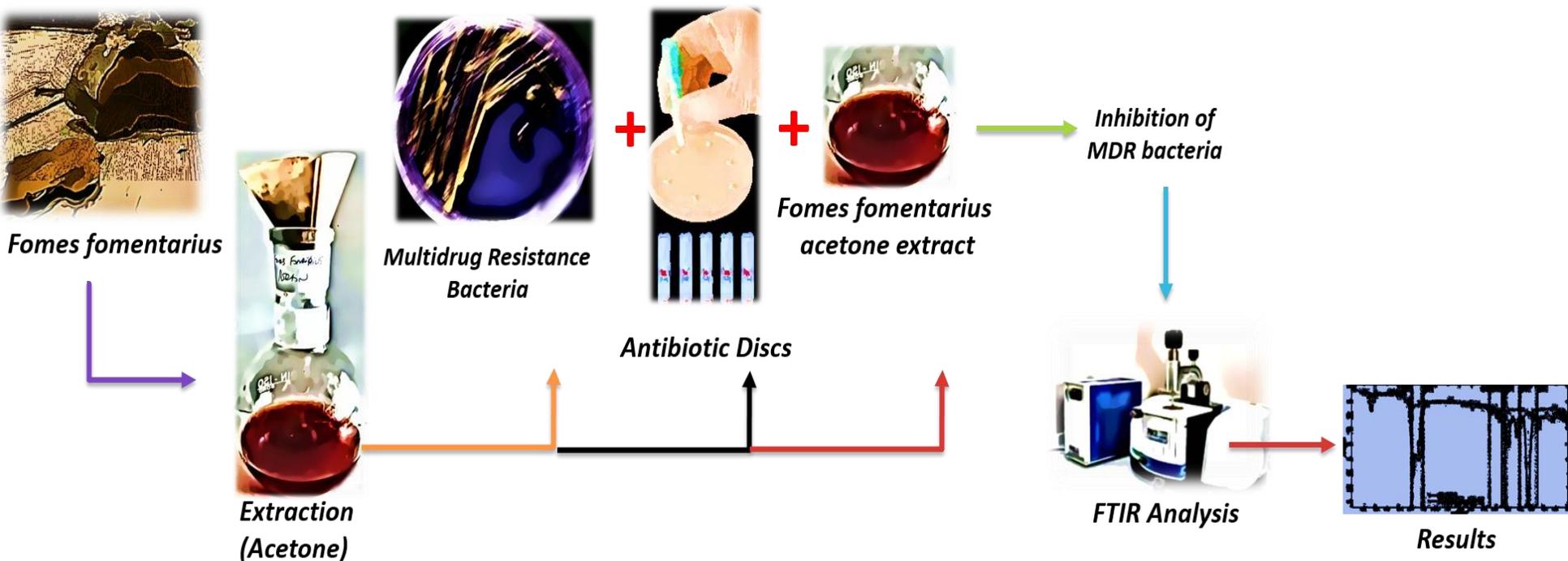
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The FTIR Analysis of Some Macrofungus Extract-Antibiotic Interactions in Some Multi Drug Resistant (MDR) Bacterial Strains Having Active Efflux Pumps

Graphical Abstract



Abstract

Antibiotics are compounds that can stop the reproduction or kill microorganisms, but for some reason, microorganisms in time show resistance to antibiotics. Using efflux pumps, the antibiotic entered into the bacterial cell is pumped out; therefore, it cannot act against bacteria. This situation increases antibiotic resistance in bacteria. Thus, microorganisms will develop multiple drug resistance against not only the antibiotic used but also many other antibiotics and rapidly spread to the environment. For this reason, antibiotic resistance has become a major problem all over the world, and new antibiotics and efflux pump inhibitor studies, which can affect these microorganisms that are resistant to multiple drugs are continuing rapidly. In this study, the behavior of 7 *Escherichia coli*, 1 *Acinetobacter baumannii*, 1 *Enterococcus faecium*, and 1 *Klebsiella pneumoniae* strains having active efflux pumps and developed multidrug resistance, against both fungal extracts and the current efflux pump inhibitor verapamil were investigated. In this study, the effects of some extracts in combination with antibiotics on MDR bacteria were investigated. The research was conducted using FTIR analysis. The FTIR results provided information about the mode of action of the extracts. According to the results of the FTIR analysis; in the extract - antibiotic combinations in which the inhibiting activities were seen, changes were observed mainly in fatty acids, proteins, carboxyl groups of free amino acids, polysaccharides, RNA/DNA, and also changes in the fingerprint region. It is important to carry out further studies in terms of confirming and expanding the data obtained.

Keywords: antibiotic resistance; efflux pumps; ftir analysis; macrofungus; multidrug resistance

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Introduction

- ❖ *Escherichia coli* (7) *Acinetobacter baumannii* (1), *Enterococcus faecium* (1) and *Klebsiella pneumoniae* (1) bacteria are multidrug resistant and their efflux pumps are active.
- ❖ **Acetone extract of *Fomes fomentarius* macrofungus** was obtained.
- ❖ The antibiotic resistant bacteria and the extract were used together to examine the efflux pump inhibition activity.
- ❖ FTIR analysis was performed for the mode of action of the extract.
- ❖ In the extract - antibiotic combinations having inhibition activities were *E. coli* #3 + Aztreonam(ATM) (30µg), *E. coli* #10 + Aztreonam(ATM)(30µg), *E. coli* #7 + Tazobactam(TZP) (36µg), *E. coli* #8 + Tazobactam(TZP) (36µg), and *K. pneumoniae* + Ceftriaxone(CRO) (30µg). For all these, an FTIR analysis was performed.
- ❖ In the light of the results, antibiotic + bacteria and antibiotic + bacteria + extract combinations that show potential effect were compared with FTIR and their mechanisms of action were tried to be determined.

Results and discussion

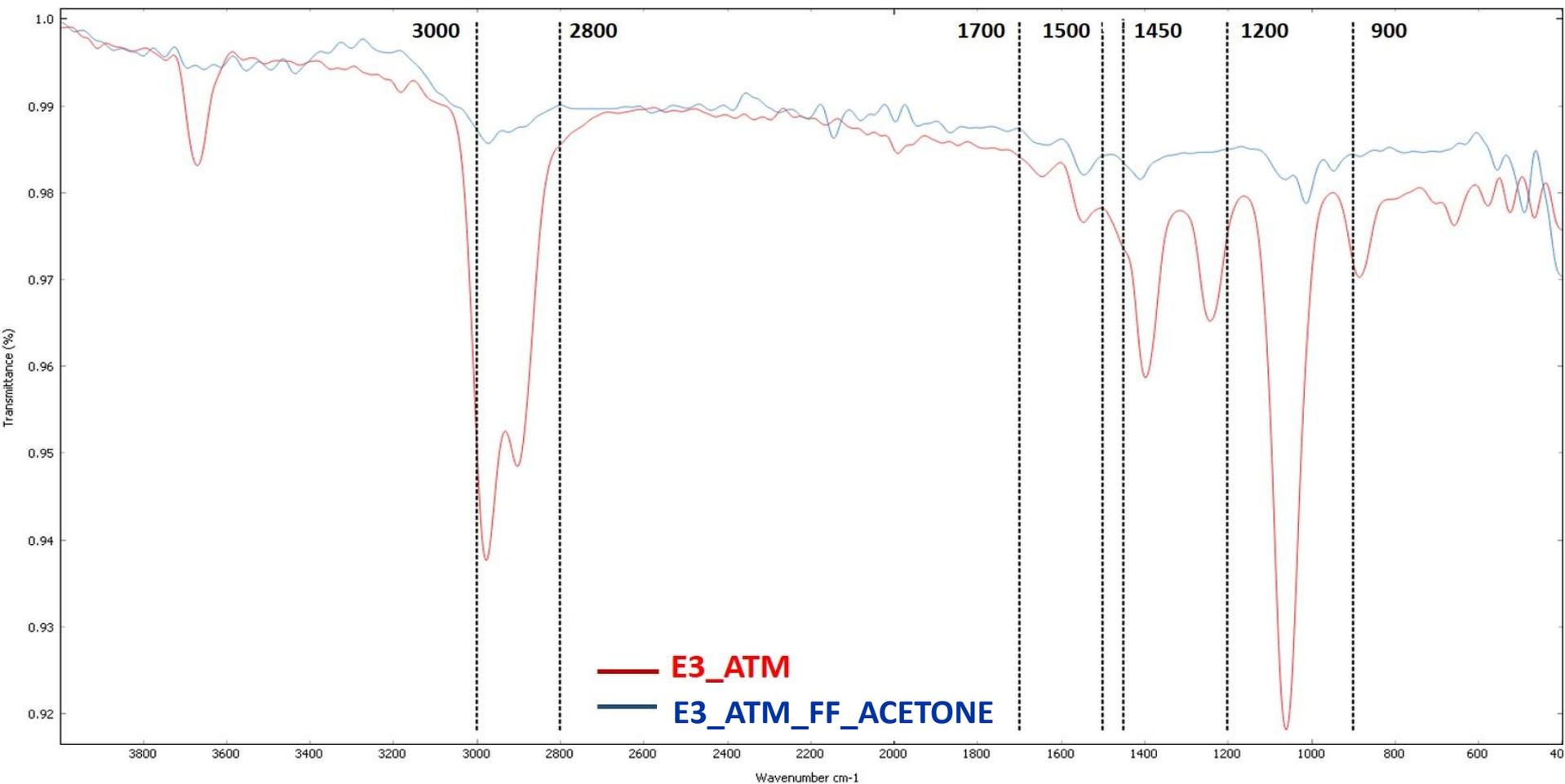


Fig. 1. *E. coli* #3 + ATM vs. *E. coli* #3 + ATM + *F. fomentarius* Acetone

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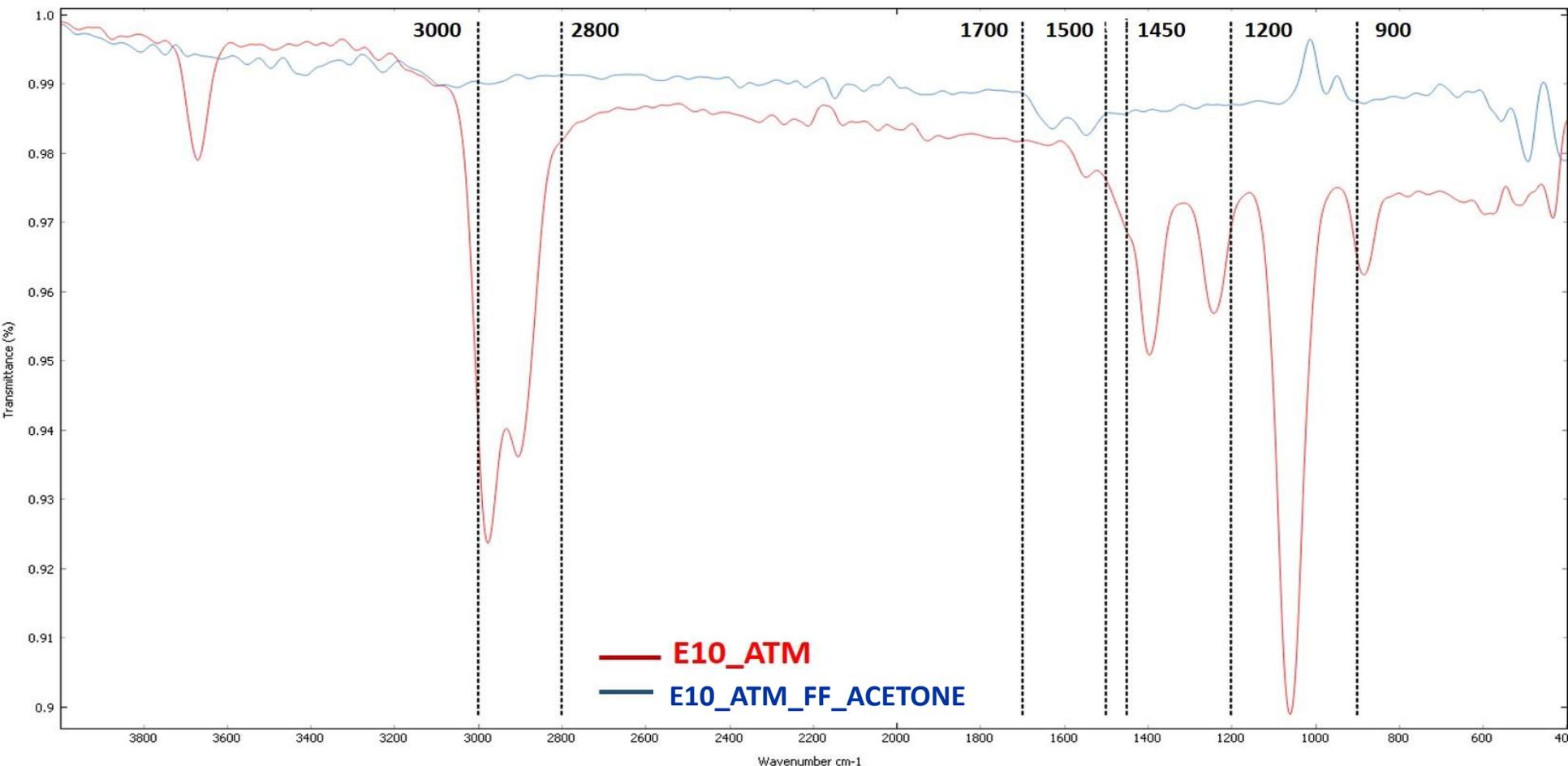


Fig. 2. *E. coli* #10 + ATM vs. *E. coli* #10 + ATM + *F. fomentarius* Acetone

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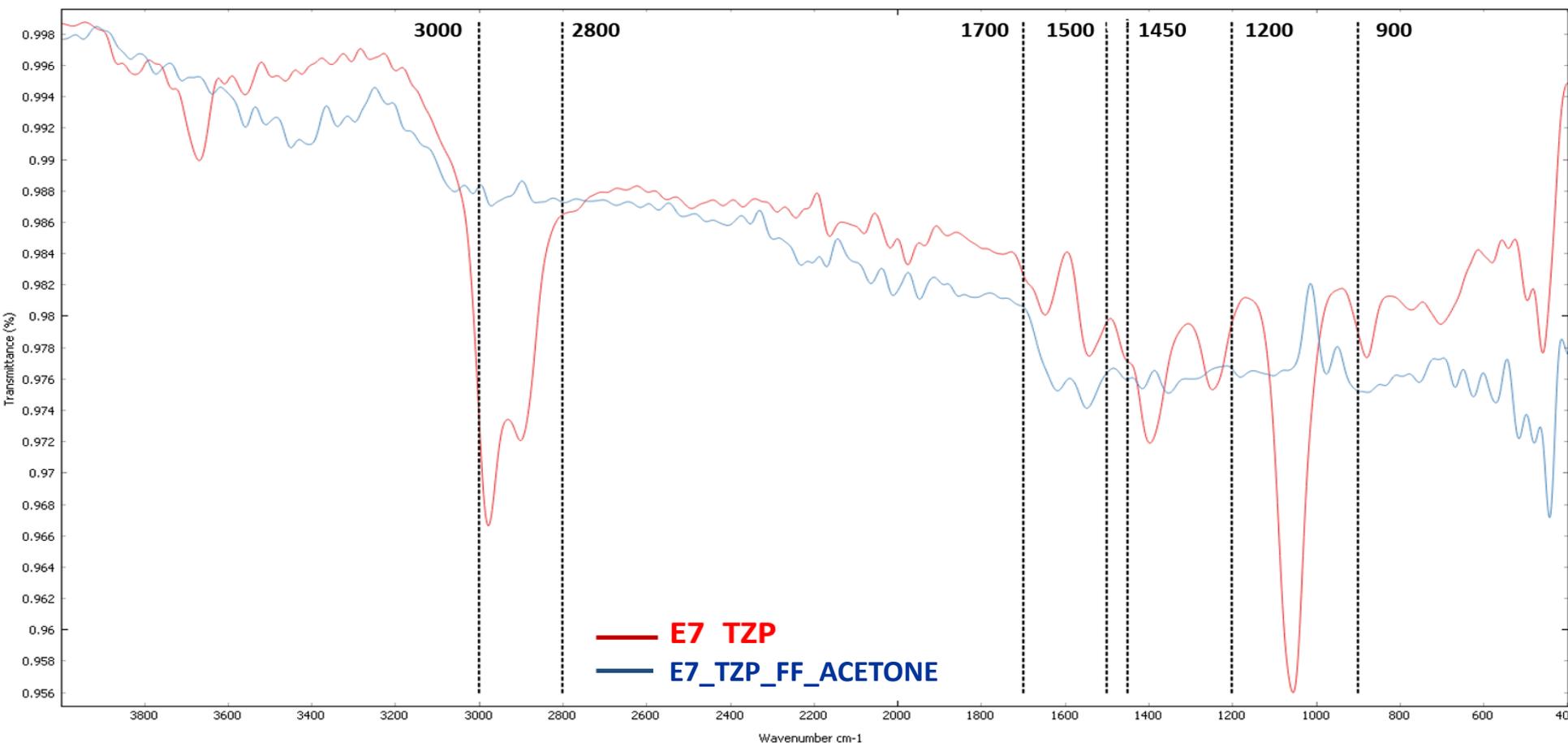


Fig. 3. *E. coli* #7 + TZP vs. *E. coli* #7 +TZP + *F. fomentarius* Acetone

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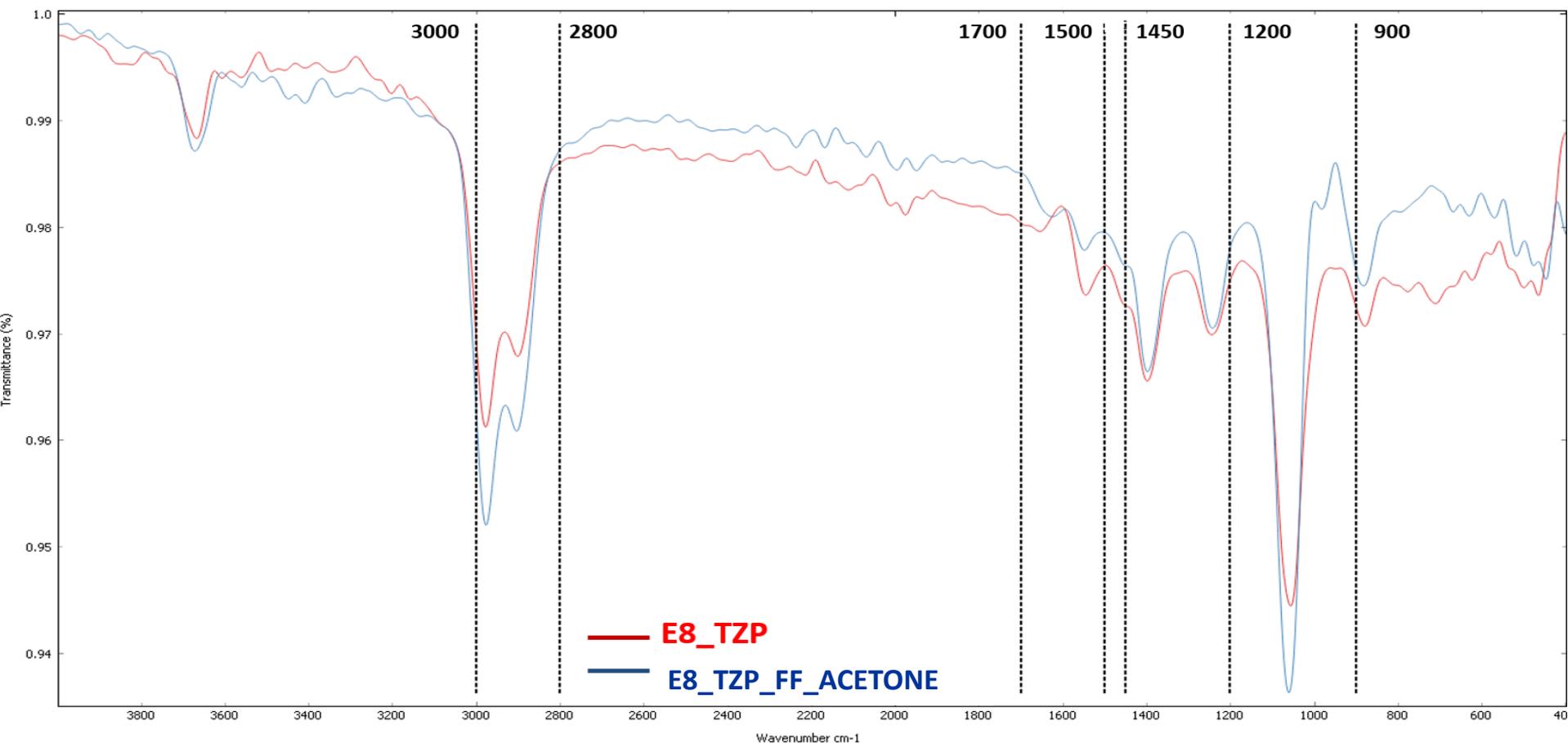


Fig. 4. *E. coli* #8 + TZP vs. *E. coli* #8 + TZP + *F. fomentarius* Acetone

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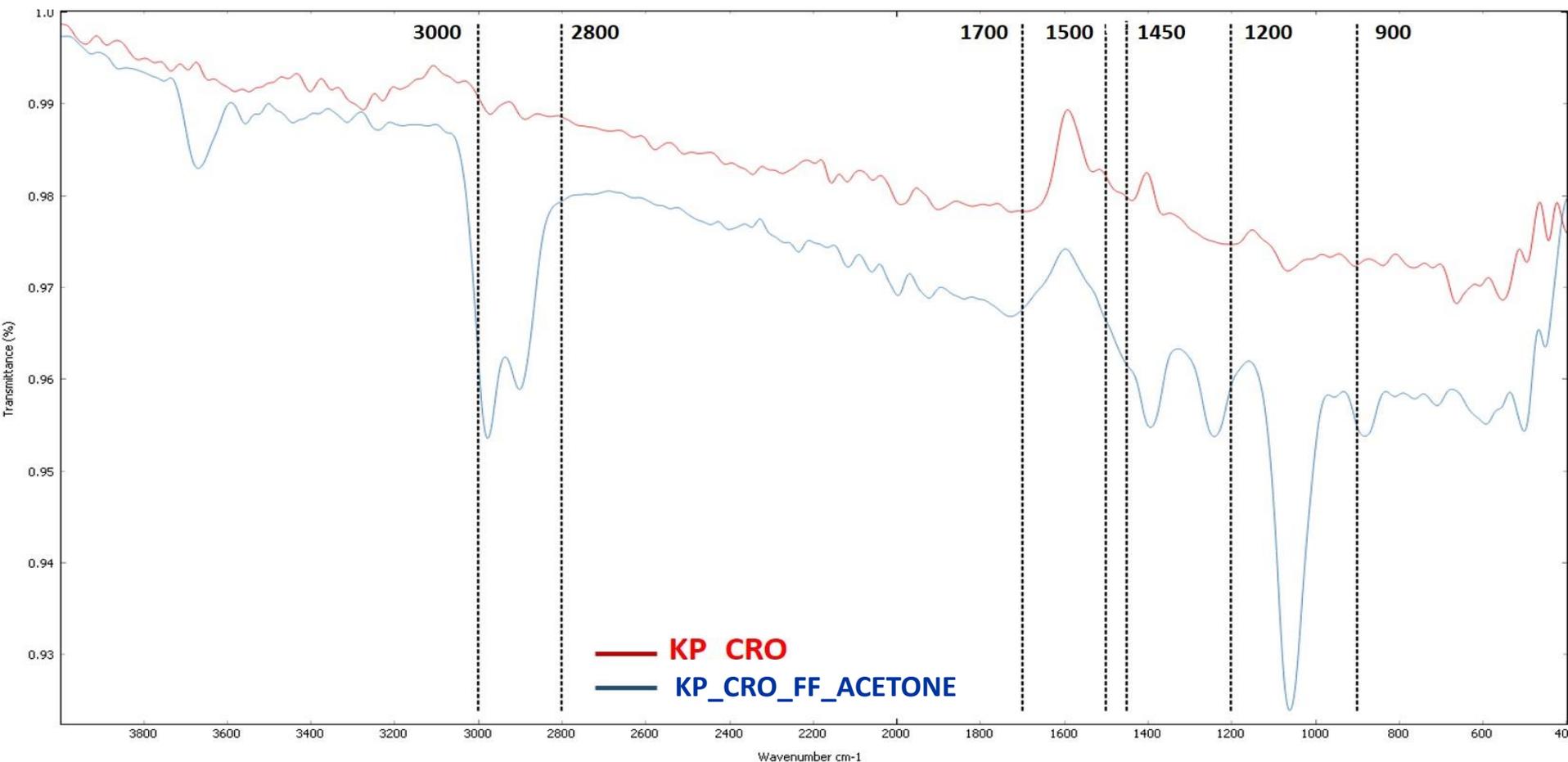


Fig. 5. *K.pneumonia* + CRO vs. *K.pneumonia* +CRO + *F. fomentarius* Acetone

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Conclusions

- ✓ When the GC/MS results of the extracts are evaluated, it is seen that the ratio of some components is quite high. For example; the ratio of *F. fomentarius* acetone extract **Nonacosane is 19.69%**.
- ✓ There is a possibility that the major components in the extracts may act as efflux pump inhibitors. For this reason, it may be recommended to concentrate on the major components in further studies.
- ✓ 3000 - 2800 cm^{-1} : commonly the C-H stretch in fatty acids appears to dominate, hence the change in lipid content.
- ✓ 1450 - 1200 cm^{-1} : changes in the content of free amino acids, polysaccharides (especially 1450 – 1400 cm^{-1}), RNA/DNA and phospholipid (especially 1250 - 1200 cm^{-1}) carboxyl groups appear to dominate in a mixed manner.
- ✓ 1200 - 900 cm^{-1} : change in polysaccharides appears dominant.

Conclusions

- ✓ So, the FTIR results provide information about the potential effects of the extracts.
- ✓ The importance of this study is that it is a preliminary study in terms of observing the effect of inhibitors from natural origin other than chemical inhibitors and it is also evaluating the potential mechanisms of action of the extracts by FTIR analysis.

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Acknowledgments

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