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# Synthesis and biological activity of some novel complexes of (methylcarbamoyl)phenyl)carbamate

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## INTRODUCTION

Anthranilic acid analogues and their derivatives have significant therapeutic potential for crafting designed compounds aimed at regulating cancer-causing pathways and addressing metabolic challenges linked to diabetes, antiviral agents, and biologically tolerant anti-inflammatory compounds. This motivated us to synthesize metal complexes of (methylcarbamoyl)phenyl)carbamate and assess their biological effects as anthranilic acid derivatives.

## RESULTS

SYNTHESIS OF Cu(II), Ni(II), Co(II) COMPLEXES

(0,0002 mol) $Cu(II)Cl_2$ in 5 mL $H_2O$;
0,0498 g (0,0002 mol) $Ni(CH_3COO)_2$. $4H_2O$ in 5 mL $H_2O$; 0,0498 g (0,0002 mol) $Co(CH_3COO)_2$. $4H_2O$ in 5 mL $H_2O$;
0,0889 g (0,0004 mol) of L in 5 mL DMSO;
0,016 g (0,0004 mol) NaOH in 5 mL $H_2O$.

The ligand (methylcarbamoyl)phenyl)carbamate (0,0004 mol) was dissolved in DMSO and the water solution of the corresponding metal salts (Cu(II), Ni(II), Co(II)) (0,0002 mol) was added dropwise to it. The above mixture was stirred with an electromagnetic stirrer for 3 h. The complexes obtained were filtered, washed with $H_2O$ and dried. (Yield: 31-35%).

## DISCUSSION

***Table 1. Antimicrobial activity of (2-(methylcarbamoyl)phenyl)carbamate and its complexes***

| Test microorganisms | Inhibition zones, mm | | | |
|---|---|---|---|---|
| | L | Cu(II)L | Ni(II)L | Co(II)L |
| *Bacillus amyloliquefaciens* 4BCL-YT-- | 8 | - | - | 10 |
| *Staphylococcus aureus* ATCC 25923 | - | - | - | 13 |
| *Listeria monocytogenes* NBIMCC 8632 | - | - | - | 15 |
| *Enterococcus faecalis* ATCC 29212 | - | - | - | 9 |
| *Micrococcus luteus* 2YC-YT | 8 | - | - | 20 |
| *Salmonella enteritidis* ATCC 13076 | - | - | - | 11 |
| *Salmonella typhimurium* NBIMCC 1672 | - | 9 | - | 11 |
| *Klebsiella pneumonia* ATCC 13883 | - | - | 12 | 13 |
| *Proteus vulgaris* ATCC 6380 | - | - | - | 13 |
| *Candida albicans* NBIMCC 74 | 8 | - | - | - |
| *Saccharomyces cerevisiae* ATCC 9763 | 9 | - | - | - |
| *Aspergillus niger* ATCC 1015 | 8 | 8 | 9 | 9 |
| *Aspergillus flavus* | 8 | - | - | - |
| *Penicillium chrysogenum* | 9 | - | - | - |
| *Rhizopus sp.* | 8 | - | 8 | - |
| *Fusarium moniliforme* ATCC 38932 | 8 | 8 | 8 | - |

***Table 2. Selected experimental data from the IR spectra of the complexes Cu(II)L, Ni(II)L, Co(II)L and of the free ligand, $cm^{-1}$***

| Assignment | L | Cu(II)L | Ni(II)L | Co(II)L |
|---|---|---|---|---|
| ν(OH) | - | 3435 | 3436 | 3442 |
| ν(NH, -C(=O)-NH-$CH_3$) | 3345 | 3345 | 3345 | 3345 |
| ν(NH, -NH-C(=O)$OCH_2CH_3$) | 3258 | 3188 | 3190 | 3189 |
| ν($C_{sp2}$-H, -Ph) | 3072 | 3058 | 3060 | 3058 |
| ν(C=O) | 1739 | 1717 | 1718 | 1717 |
| δ(NH) + ν(C=O), -C(=O)-NH-$CH_3$) | 1664 | 1665 | 1666 | 1665 |
| δ(NH) + ν(C=O), -NH-C(=O)$OCH_2CH_3$) | 1633 | 1645 | 1645 | 1645 |
| $\delta_s(CH_3)$ | 1390 | 1386 | 1386 | 1386 |
| $\nu_{as}$(N-C=O-O-) | 1218 | 1219 | 1218 | 1218 |

***Table 3. $^1$H- NMR data for (methylcarbamoyl)phenyl)carbamate (L) and their complexes with Cu(II), Ni(II) u Co(II)***

| Atom | δ ($^1$H) ppm L | δ ($^1$H) ppm Cu(II)L | δ ($^1$H) ppm Ni(II)L | δ ($^1$H) ppm Co(II)L |
|---|---|---|---|---|
| NH(COO) | 10.96 (s) | 11.42 (br.s) | 10.96 (br.s) | 11.40 (br.s) |
| NH (C=O) | 8.72 (q) | | | 10.97 (br.s) |
| CH | 8.19 (dd) | 7.92 (br.s) | 7.92 (br.s) | 7.92 (br.s) |
| CH | 7.70 (dd) | 7.64 (br.s) | 7.63 (br.s) | 7.64 (br.s) |
| CH | 7.48 (ddd) | 7.18 (br.s) | 7.18 (br.s) | 7.18 (br.s) |
| CH | 7.08 (ddd) | 7.18 (br.s) | 7.18 (br.s) | 7.18 (br.s) |
| C | - | - | - | - |
| C | - | - | - | - |
| $NHCH_3$ | 2.78 (d) | 3.26 (br.s) | 3.25 (br.s) | 3.25 (br.s) |
| $COOCH_3$ | 3.68 (s) | 3.68 (s) | 3.68 (s) | 3.68 (s) |

***Table 4. $^{13}$C- NMR data for (methylcarbamoyl)phenyl)carbamate (L) and their complexes with Cu(II), Ni(II) u Co(II)***

| Atom | δ ($^{13}$C) ppm L | δ ($^{13}$C) ppm Cu(II)L | δ ($^{13}$C) ppm Ni(II)L | δ ($^{13}$C) ppm Co(II)L |
|---|---|---|---|---|
| NH(**COO**) | 152.92 | 150.37 | 150.44 | 150.39 |
| NH(**C=O**) | 168.71 | 162.19 | 162.22 | 162.19 |
| CH | 127.95 | 127.27 | 127.26 | 127.26 |
| CH | 118.60 | 115.07 | 115.15 | 115.09 |
| CH | 132.07 | 134.86 | 134.83 | 134.82 |
| CH | 121.71 | 122.44 | 122.37 | 122.40 |
| C | 139.22 | 139.31 | 139.47 | 139.37 |
| C | 119.58 | 113.68 | 113.70 | 113.68 |
| $NHCH_3$ | 26.22 | 27.01 | 27.01 | 27.00 |
| $COOCH_3$ | 52.50 | 52.54 | 52.56 | 52.51 |

***Table 5. Analytical and physical characteristic of metal complexes with (methylcarbamoyl)phenyl)carbamate (L)***

| Complexes | Colour | Yield (%) | Melting point (°C) | Solubility |
|---|---|---|---|---|
| L | colorless | - | 136-137 | soluble in DMSO and $CHCl_3$ |
| Cu(II) | bright blue | 35 | 243-245 | soluble in DMSO and insoluble in $H_2O$, THF, $CH_3COCH_3$, EtOH, EtOAc and $C_6H_{12}$. |
| Ni(II)L | bright green | 31 | 245-247 | soluble in DMSO and insoluble in $H_2O$, THF, $CH_3COCH_3$, EtOH, EtOAc and $C_6H_{12}$. |
| Co(II)L | purple | 33 | 240-241 | soluble in DMSO and insoluble in $H_2O$, THF, $CH_3COCH_3$, EtOH, EtOAc and $C_6H_{12}$. |

## CONCLUSIONS

1. Three new coordination compounds of (2-(methylcarbamoyl)phenyl)carbamate with Cu(II), Ni(II) and Co(II) were obtained.
2. The novel complexes were spectrally characterized by their melting points, IR, $^1$H- and $^{13}$C-NMR spectra. Based on the data obtained from the mass concentration the probable composition of the Co and Ni complexes was also determined.
3. Based on the spectral data obtained, we could conclude that the following atoms are involved in the coordination with the metal center: two oxygen and one nitrogen from the amide group of the ligand, which suggests the formation of a chelate structure.
4. From the studies on the antibacterial activity of (2-(methylcarbamoyl)phenyl)carbamate and its complexes with Cu(II), Ni(II), Co(II), we can summarize that: Only the Co(II)L complex shows high antimicrobial activity against all G(+) and G(-) bacteria by inhibiting their growth, while the yeast *Candida albicans* NBIMCC 74, *Saccharomyces cerevisiae* ATCC 9763 and all fungi included in the experiment are resistant to its action.