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SYNTHESIS OF PHENANTRIDINONES AND BENZOCHROMENES BY C-H ACTIVATION REACTIONS CATALYSED BY PALLADIUM NANOPARTICLES

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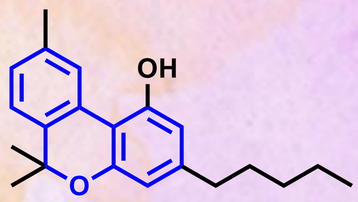
BACKGROUND

The synthesis of complex molecules by Pd-catalyzed reactions has been extended to the use of metallic nanoparticles (NPs) due to their unique physical and chemical properties. Phenanthridin-6(*5H*)-ones and benzo[c]chromenes are aromatic nuclei of great interest present in natural products with diverse biological properties. Several synthetic routes have been developed to obtain these compounds, one of them being Pd-catalyzed C-H bond activation reactions. Although very good yields are achieved with these routes, the reaction conditions involve high catalyst loads, high temperatures, the use of ligands and the use of environmentally unfriendly solvents.

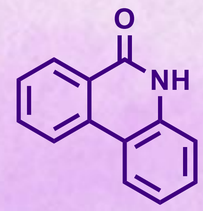
Benzochromenes

Cannabinol
Derivate with antiemetic, analgesic and anticonvulsant propieties



Phenantridinones

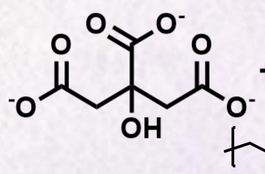
. Phenanthridin-6(*5H*)-one Inhibitor of poly(ADP-ribose) polymerase (PARP).



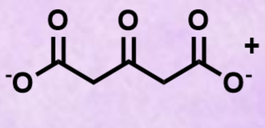
OBJETIVE

- Synthesize **Benzo[c]chromenes** and **Phenanthridin-6-(*5H*)-ones** by C-H Activation reactions catalyzed by Pd nanoparticles
- Develop of sustainable reaction conditions
- Evaluate the synthetic scope of catalytic systems

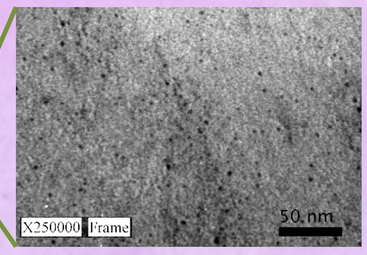
PHOTOINDUCED SYNTHESIS OF Pd NPs

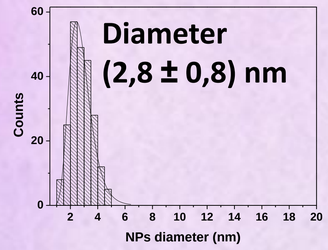
H_2PdCl_4 +  + PVP

$h\nu$, N_2, H_2O, RT, 1h

NPs Pd-PVP +  + CO_2

PVP: Polyvinylpyrrolidone





✓ **Use of visible light and aqueous media for the nanocatalyst synthesis**

✓ **Excellent catalytic activity in reductions, coupling reactions (C-C), and C-H bond activation reactions**

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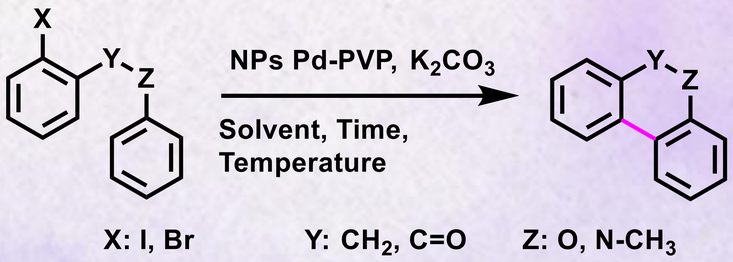
OPTIMIZATION OF REACTION CONDITIONS



X: I, Br Y: CH_2, C=O Z: O, N-CH_3

Catalyst
5%- 0,5% NPs Pd

Additive: PivOH

Time
48 h- 12h

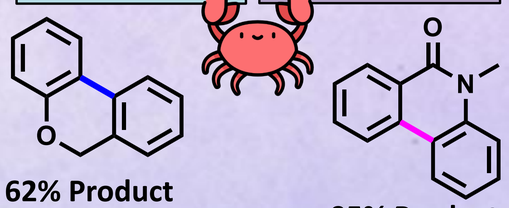
Temperature
140°C- 65°C

Solvent
DMA-H_2O
EtOH-H_2O
THF-H_2O
H_2O

Best Conditions

5% NPs Pd-PVP, 48 h, DMA-H_2O, K_2CO_3, 100°C, Air

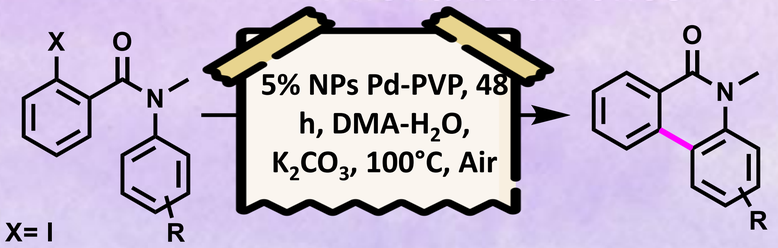
1% NPs Pd-PVP, 24 h, H_2O, K_2CO_3, 100°C, Air



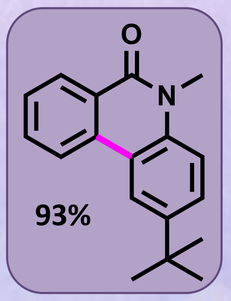
62% Product
7% Reduced Substrate

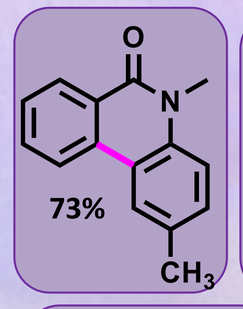
95% Product
(88% Isolated)

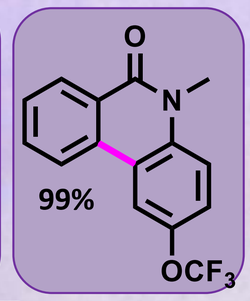
Phenantridinones

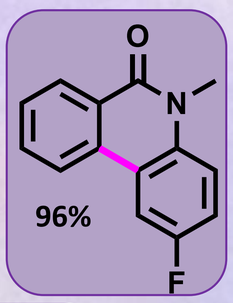


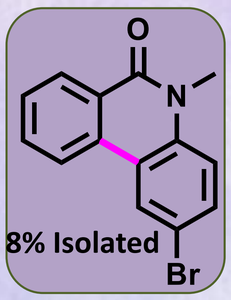
X= I



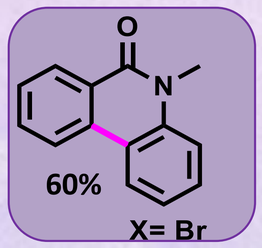




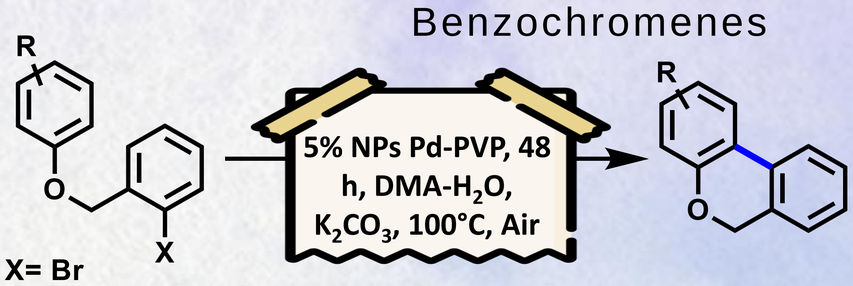




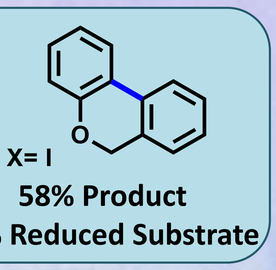
X= Br



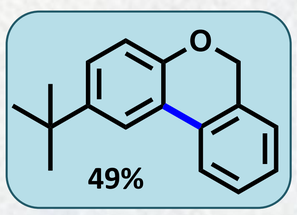
Benzochromenes

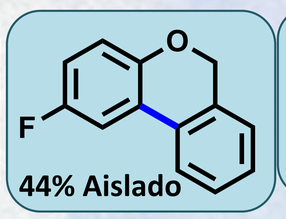


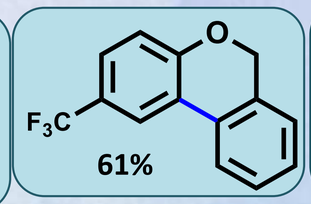
X= I

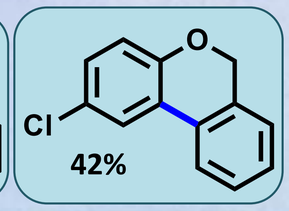


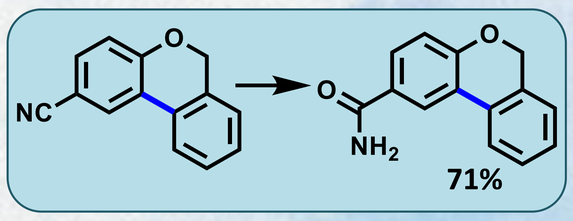
58% Product
30% Reduced Substrate

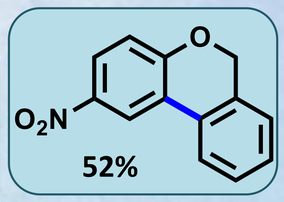


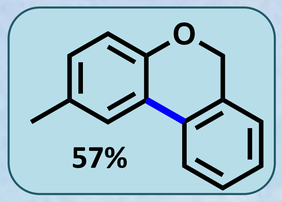




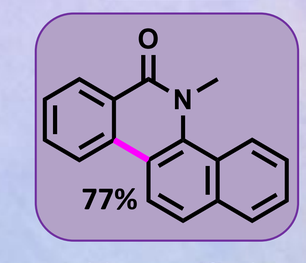




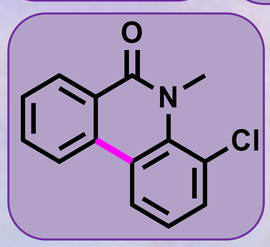




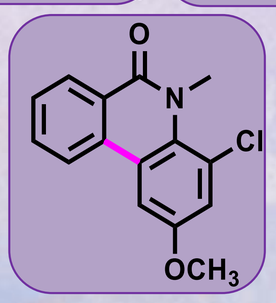
Yield quantified by ^{1}H NMR



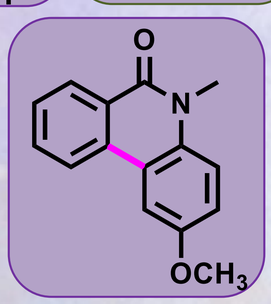
Yield quantified by ^{1}H NMR



70% Isolated
(1% NPs Pd-PVP , K_2CO_3, 100 °C, H_2O-DMA (3:1), 24 h)



83%
(2% NPs Pd-PVP , K2CO3, 100 °C, H2O-DMA (1:1), 24 h)



98%
(2% NPs Pd-PVP, K2CO3, 100 °C, H2O-DMA (1:1), 24 h)

CONCLUSIONS

Phenanthridin-6-(5H)-one and benzo[c]chromene derivatives were obtained in moderate to excellent yields with brominated and iodinated substrates in aqueous media.

Phenanthridin-6-(5H)-one
- They were obtained with good to excellent yields (70-97%)
- Protection of the NH group was necessary to achieve the desired reactivity.
- Amides with strong donor groups such as –OCH3 or with weak acceptor groups in the –ortho position show high reactivity at low catalyst loadings.

Benzo[*c*]crhomenes
- Tolerates various substituent groups in position–*para*
- The electronic nature of the functional groups on the aryl ring does not significantly affect the yield of the product obtained.

The results of this work were published:
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(DOI: 10.1039/D4RA02835J)

https://syc.investigacion.unc.edu.ar/

ACKNOWLEDGEMENTS