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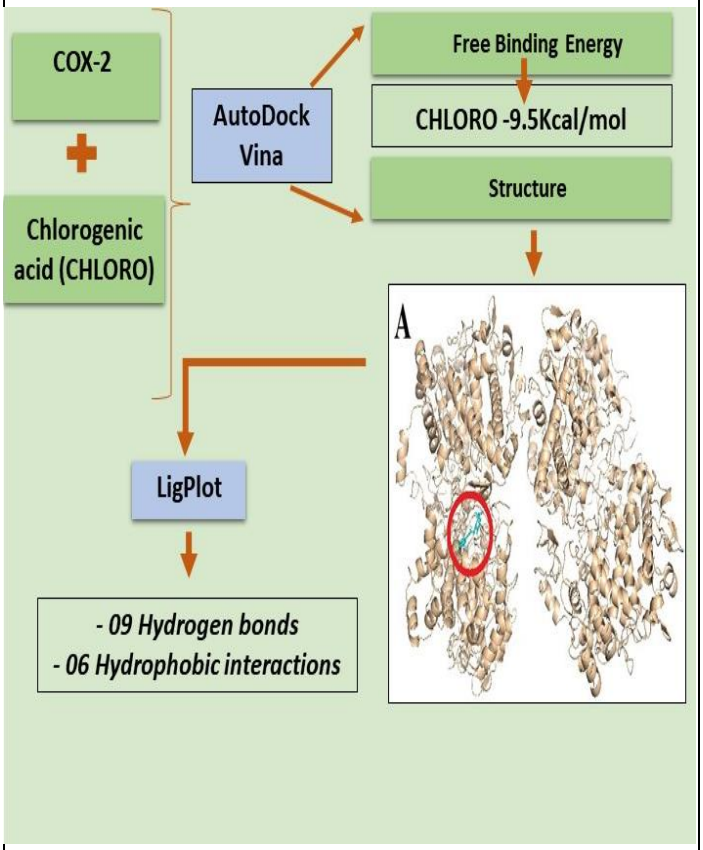
A possible anti-inflammatory capacity of chlorogenic acid

Paula Fernandes e Silva [b]; Estela Fernandes e Silva [a*];; Timóteo Matthies Rico [c]; Juliana Silva Lemões [d]*

a Dentist by Universidade Federal de Pelotas, Pelotas (Rio Grande do Sul), Brasil
b Doctor in Physiological Sciences by Universidade Federal do Rio Grande - FURG, Rio Grande (Rio Grande do Sul), Brasil
c Doctor in Health Sciences by Universidade Federal do Rio Grande - FURG, Professor at Instituto-Federal-Sul-Riograndense, Jaguarão (Rio Grande do Sul), Brasil
d Doctor in Chemistry by Universidade Federal do Rio Grande do Sul – UFRGS, Professor at Universidade Federal do Pampa, Bagé (Rio Grande do Sul), Brasil
**e-mail address: star.fs@hotmail.com; paulafernandes.es@gmail.com*

Graphical Abstract



Abstract. Inflammatory processes, although important for tissue homeostasis, can suffer imbalances and be related to several diseases. An important enzyme involved in the mediation of inflammatory processes is cyclooxygenase 2 (COX-2), which generates prostaglandins from arachidonic acid. In this context, this enzyme is an important drug target and its inhibition is a mechanism present in several anti-inflammatory drugs. The chlorogenic acid (CHLORO) could act in an inhibitory way on COX-2 and there are reports of anti-inflammatory actions of this molecule. To evaluate the possible inhibitory power on COX-2 of chlorogenic acid through molecular docking was the objective of this study. The docking simulation by AutoDock Vina demonstrated a binding energy with the COX-2 of -9.5 Kcal/mol. Besides that, COX-2 and CHLORO stablished 09 Hydrogen bonds and 06 hydrophobic interactions. The binding energy and types of binding established with COX-2 can demonstrate the anti-inflammatory properties of the CHLORO. In this sense, it would be important to continue *in vitro* and *in vivo* studies.

Introduction

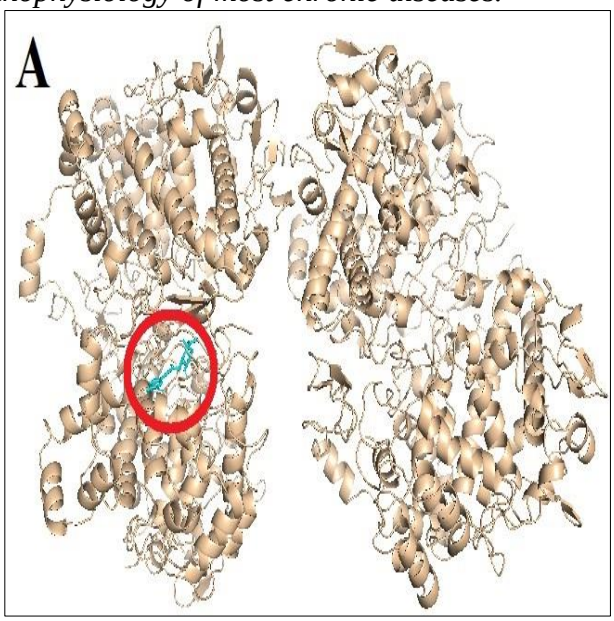
Inflammation is one of the most fundamental and pronounced protective reactions of the organism (1). *However, broader reach of inflammatory processes, to the current day when these processes are seen as integral to the pathophysiology of most chronic diseases* (2). *An important enzyme involved in the mediation of inflammatory processes is cyclooxygenase 2 (COX-2), which generates prostaglandins from arachidonic acid* (3). *The inhibition of COX-2 is a mechanism present in several anti-inflammatory drugs like acetylsalicylic acid* (4). *Chlorogenic acid (CHLORO), belonging to the class of quinic acids* (5), *could act in an inhibitory way on COX-2, as there are reports of anti-inflammatory actions of these molecules* (6). *To evaluate the possible inhibitory power on COX-2 of chlorogenic acid through molecular docking was the objective of this study.*

Materials and Methods

The COX-2 structure (receptor) was obtained from Protein Data Bank PDB (PDB ID: 1CX2) (7) *and ligand CHLORO was obtained from Pubchem (PubChem ID: 1794427)* (5). *Firstly, using the UCSF chimera (available to download at http://www.cgl.ucsf.edu/chimera/download.html*) *we remove heteroatoms from the COX-2. Then, we prepare receptor and ligand input files using AutoDockTools software for AutoDockVina* (8). *To perform docking simulations, we configure grid box as: size x = 94 Å; size y = 76 Å; and size z = 124 Å; and center box coordinates are x = 42.335 Å center; y = 33.591 Å center; z = 36.078 Å; considering exhaustiveness as 200. Molecular docking simulations were performed with AutoDock Vina* (8). *The more negative FEB indicates the greater stability of ligand-receptor complex. Visual analysis of docking results was performed with PyMol (available for download https://pymol.org/2/) and for check the types of connections between molecules we used the LigPlot* (9).

Results and Discussion

The docking simulation by AutoDock Vina demonstrated a binding energy with the COX-2 of -9.5 Kcal/mol. Besides that, COX-2 and CHLORO stablished 09 Hydrogen bonds and 06 hydrophobic interactions (Fig. 1B). The binding energy and types of binding established with COX-2 can demonstrate the anti-inflammatory properties of the CHLORO. Bhandarkar et al., (2019) (6) *demonstrated that chlorogenic acid attenuated diet-induced inflammation. In this sense, it is interesting to continue studies on the anti-inflammatory potential of chlorogenic acid, since inflammation seen as integral to the pathophysiology of most chronic diseases.*



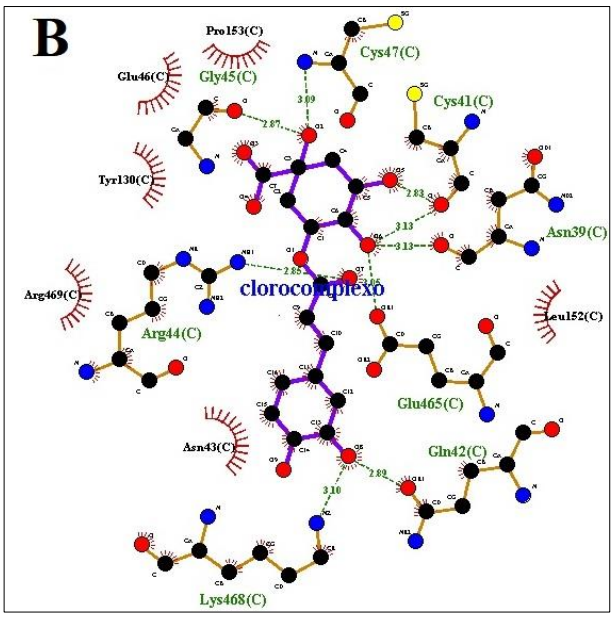


Figure 1: COX-2 (wheat color) and Chlorogenic acid (pink strokes with red circle around) (A). COX-2 and Chlorogenic acid interaction (B). For B: Black, blue, red, yellow circles – COX-2 or Chlorogenic acid atoms; Purple strokes – bonds between the atoms of Chlorogenic acid; Orange strokes – bonds between the atoms of COX-2; Dotted green lines – Hydrogen bonds with distances (numbers) between COX-2 and Chlorogenic acid (B); Red semi-circles with lines - hydrophobic interactions.

Conclusions

The docking results reveal that the Chlorogenic acid is promising molecules para inibir COX-2. However, it would be important to continue in vitro and in vivo studies.

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