

# Chapter 11

## Food Grade Biopolymer Corrosion and Biocorrosion Inhibition: Case Study of Chitin and Chitosan

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### ABSTRACT

*Metal corrosion is a major global concern in many economic sectors. Specifically, in the food and pharmaceutical industry, stainless steel is exposed to heat, water, and harsh cleaning chemicals. Through those exposures, food grade stainless steel must remain durable, corrosion free, and be easy to sanitize. These features are crucial because produced foodstuffs and drugs must comply with high purity and quality standards. Just a proper selection of stainless-steel grade can prevent corrosion phenomena that can be detrimental to the whole manufacturing process. In this book chapter, the corrosion and biocorrosion inhibition of stainless steel was investigated under harsh cleaning chemicals condition (10% HCl). For that, Chitin and Chitosan are extracted successively from the pink shrimp shells of *Parapenaeus longirostris* collected from the local market of Mehdia. Their corrosion and biocorrosion inhibition potential was evaluated via standard weight loss, potentiodynamic polarization, and electrochemical impedance spectroscopy measurement.*

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## INTRODUCTION

Stainless Steel utilized in many applications such as pharmaceutical, petrochemical, generation power industries and water treatment plants. Pickling and cleaning eliminating foreign metal and stability promote, perform an arranged surface that is resistant to corrosion localized. Stainless Steel was chosen as good passivation for corrosion resistance due to a film oxide protective.

Hydrochloric acid solution causes corrosion of stainless steel (Behpour, Ghoreishi, Khayat Kashani, & Soltani, 2009; Behpour, Ghoreishi, Soltani et al, 2009). It is well known that corrosion never stops but its scope and severity can be lowered. However, corrosion control is an essential issue from application point of view, and it has been reported that inhibitors are needed to be used which act as a barrier to reduce the aggressiveness of the environments against the pitting corrosion attack (Eghbali et al., 2011; Abdallah, 2002; Fouda and Ellithy, 2009). Organic compounds are commonly used as corrosion inhibitors to reduce the corrosion attack on stainless steel in acidic media (Refaey, Taha, and Abd El-Malak, 2004; Fouda et al., 2010; Fuchs-Godec, 2009; Caliskan and Akbas, 2011). Protection efficiency of organic inhibitors is attributed mainly to the presence of a polar group acting as an active center for adsorption. Unfortunately, many common corrosion inhibitors that are still in use today are health hazards. Therefore, there is still an increased attention directed towards the development of environmentally compatible, nonpolluting corrosion inhibitors (Ghareba & Omanovic, 2010). Hazwan Hussin and Jain Kassim (Hazwan Hussin & Jain Kassim, 2011) studied the inhibitive effect of Uncaria gambir extract on the acid corrosion of mild steel in 1 M HCl solution. Okafor et al. (Okafor et al., 2008) studied the inhibitive action of leaves, seeds and a combination of leaves and seeds extracts of *Phyllanthus amarus* on mild steel corrosion in HCl and H<sub>2</sub>SO<sub>4</sub> solutions. Corrosion inhibition effect of *Justicia gendarussa* extract on mild steel in 1 M HCl medium was also studied (Satapathy et al., 2009). Rocha and coworkers (da Rocha & da Cunha Ponciano Gomes, 2010) reported the effect of aqueous extracts of mango, orange, passion fruit and cashew peels as corrosion inhibitors for carbon steel in 1 M hydrochloric acid. They showed that the inhibition efficiencies obtained in the presence of extracts followed the trend cashew < mango < passion fruit < orange. The effect of the extract of *Punica granatum* and their main constituents involve ellagic acid and tannic acid, were studied as mild steel corrosion inhibitor in 2 M HCl and 1 M H<sub>2</sub>SO<sub>4</sub> solutions (Behpour et al., 2012). Lebrini et al. (Lebrini et al., 2011) investigated the effect of alkaloids extract from *Oxandra asbeckii* plant on the corrosion of C38 steel in 1 M hydrochloric acid solution.

The effect of the molecular structure on the chemical reactivity has been object of great interest in several disciplines of chemistry and quantum-chemistry calculations have been widely used to study the reaction mechanisms and to interpret the experimental results as well as to solve chemical ambiguities. This is a useful approach to investigate the mechanisms of reaction in the molecule and its electronic structure level and the structure and electronic parameters can be obtained by means of theoretical calculations using the computational methodologies of quantum chemistry (Arslan et al., 2009; Musa, Jalgham, and Mohamad, 2012; Ashry and Senior, 2011; Oguzie et al., 2010; Obi-Egbedi, Obot, and Umoren, 2010; Behpour et al., 2011; Christensen et al., 2010; Lu and Foo, 2001). Fifteen compounds, salvigenin, lupeol, b-sitosterol, stigmasterol, physcion, carnosol, rosmadial, rosmanol, epirosmanol, isorosmanol, columbaridione, atuntzensin A, miltirone, carnosic acid and 12-O-methyl carnosic acid were isolated from the leaves of *S. officinalis* (Miura et al., 2001). The most compounds of *S. officinalis* leaves extracts, especially phenolic compounds, contain heteroatom oxygen and aromatic rings. The structure of some of these compounds has been shown in Table 1. Thus, it seems that *S. officinalis* leaves extract can be useful corrosion inhibitor.

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