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CHEMICAL COMPOUNDS USED IN SUNSCREEN ARE POTENTIAL ENDOCRINE DISRUPTORS: A MOLECULAR DOCKING STUDY

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ABSTRACT

Commercial sunscreen products are currently experiencing an increase in terms of usage as a means to reduce skin cancer produced by ultraviolet (UV) radiation from sunlight. Nevertheless, there are concerns of bioactive compounds used in the sunscreen products, which link to endocrine-disruptive compounds. In this work, we predicted the estrogenic effect of five commonly used chemical compounds in the commercial sunscreen products based on their molecular interactions with estrogen receptor (ER) -alpha and -beta. Molecular docking method was employed to study the binding between these compounds and ERs. Among the five studied compounds, enzacamene exhibited the highest binding affinity to both ER-alpha and –beta (>-9.0 kcal/mol), followed by homosalate (~-8.0 kcal/mol) and 3-benzophenone (~ -7.0 kcal/mol). Octinoxate and padimate-O exhibited binding affinity ranging from -6.3 to -6.9 kcal/mol. In summary, binding affinities of these compounds resemble the estradiol binding. Hence, the bioactive compounds used for the sunscreen products may affect the estrogen regulatory and functions.

Keywords: estrogen receptor alpha, estrogen receptor beta, molecular docking, sunscreens, enzacamene

CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

Nuclear receptors (NRs) are transcription factors which activated by ligand binding. It involved in the metabolic disorder and complications in human physiology system. Examples of diseases related with NRs are diabetes mellitus, heart diseases and cancer (Aagaard, Siersbæk, & Mandrup, 2011). NR are classified into several classes; Class 1 (endocrine receptors), Class 2 (adopted orphan receptors) and Class 3 (true orphan receptors).

Estrogen receptors (ERs) are members of nuclear receptor family. It regulates the endocrine system in our body. Any changes either too high or too low expression of estrogen receptor can cause a major effect that may disrupt the endocrine function. ERs consists of two types of receptors; ER-alpha and ER-beta which is highly distributed in human breast cells, endometrium, prostate gland, brain, lung and bone (Deroo & Korach, 2006).

Sunscreens products are currently experiencing a dramatic increase in terms of usage. This happened since many studies done proven that the application of sunscreen indeed cause cancer (Kunz & Fent, 2006; Marrot & Meunier, 2008). The ultraviolet radiation can cause a lethal effect to human skin such as skin cancer and skin ageing. It also has a properties of endocrine disrupting agents (Schlumpf, Jarry, Wuttke, Ma, & Lichtensteiger, 2004).

Computational drug design (CDD) has shown to assist many changes in drug discovery pipeline. Structure-based drug design (SBDD) is one of the computer aided drug design tools that combines receptor and ligands information to predict their interaction. Molecular docking is a part of the CDD and SBDD which is a useful and important tool used to predict the binding