# The Use Of Theoretical Mechanistic Biochemistry (TMB) In The Rationalization Of The Experimental Data On Sacoglottis Gabonensis On The Natural Antioxidant Defense During 2,4-Dinitrophenyl Hydrazine Administration In-Vivo

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**Abstract**

## INTRODUCTION

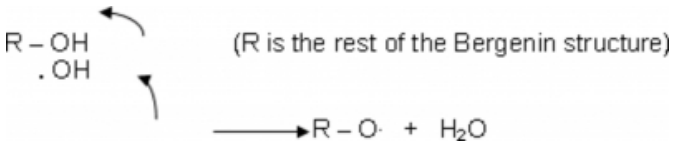
Sacoglottis gabonensis stem bark, a Nigerian alcoholic beverage additive has stimulated interest as an antioxidant (Ekong and Ejike, 1974; Madusoluomu, 1993; Okechukwu, 1998 and Maduka and Okoye 2002). Based on the structure of bergenin (Fig. 1), this study will present the use of Theoretical Mechanistic Biochemistry (TMB) (Akintonwa, 1986, Akintowa, 1995; Akintonwa, and Odigwe 2000; Akintonwa 2000, Akintonwa, 2001, Akintonwa, 2002) to rationalize the antioxidant propensity of bergenin on 2,4 dinitrophenylhydrazine, alcohol dehydrogenase and superoxide dismutase (SOD).

## MATERIALS AND METHODS

### BERGENIN STRUCTURE (FIG. 1)

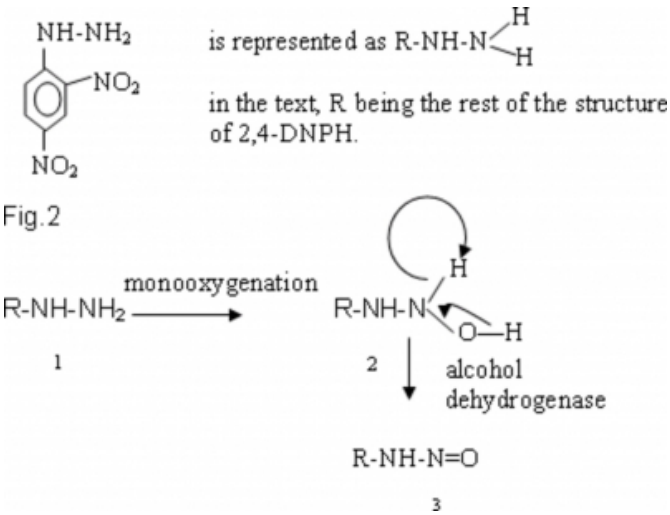
Bergenin with 4–OH constituents should be capable of mopping off free hydroxyl radical –OH

**Figure 1**




2,4-dinitrophenyl hydrazine( 2,4-DNPH).

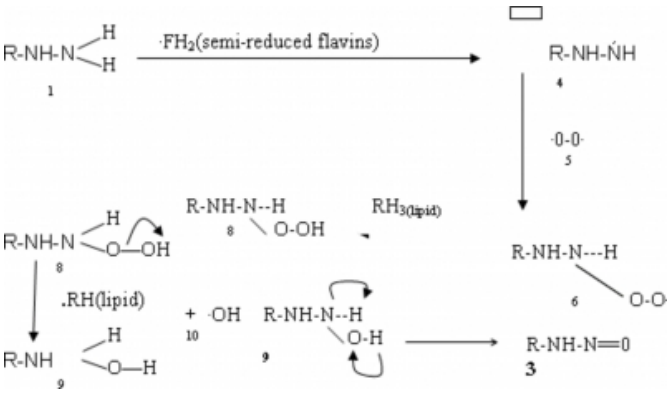
**Figure 2**




Scheme1:Generation of 2,4-dinitrophenyl nitrosamine,3 from 2,4-DNPH.

Scheme 1 is a modification of Maduka and Okoye(2002).

**Figure 3**

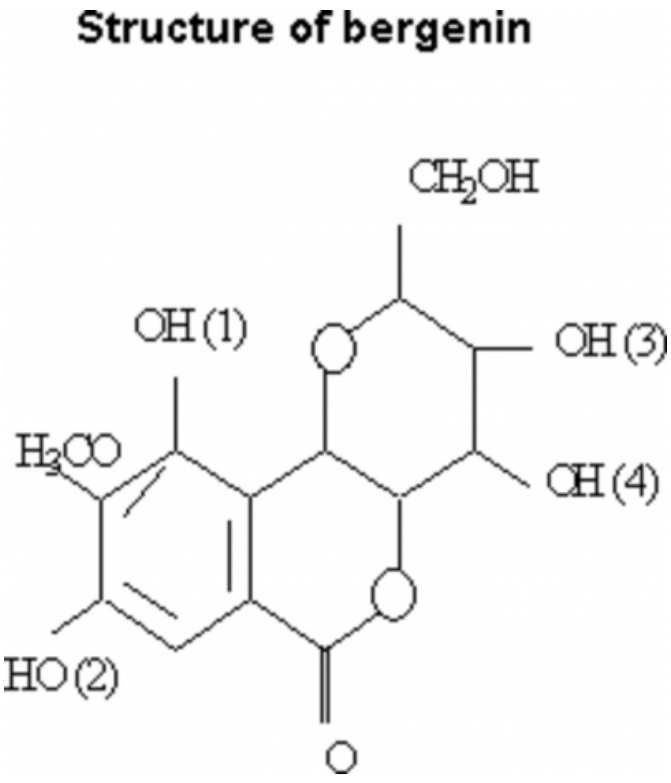



## RESULTS AND DISCUSSION

### BERGENIN

Bergenin by TMB in this study is a potent antioxidant because of its rapid potential for the removal of ·OH (hydroxyl free radical). If it does not do that in this study, it is not antioxidant.

**Figure 4**




### 2, 4 DNPH

In this study, as shown in scheme 1, 2,4 dinitrophenylnitrosoamine, 3 has been generated. Scheme 2, has also generated ·OH, 10 and 2,4 dinitrophenylnitrosoamine from 2,4 DNPH (Akintonwa, 1986).

### TMB DATA

OH should be capable of destroying alcohol dehydrogenase, superoxide dismutase (SOD) and glutathione peroxidase because they are proteins. This radical is capable of reacting with nucleophilic centres of proteins, DNA and RNA. ·OH is potentially damaging to all biological cells (Akintonwa, 1986).

Bergenin and therefore, Sacoglottis gabonensis stem bark extract should be capable of scavenging ·OH satisfactorily.

### TMB DATA VERSUS EXPERIMENTAL DATA

It was concluded experimentally that the extract bergenin (Fig. 1) “may possess antioxidant properties” (Ekong and Ejike, 1974, Madusolumuo, 1993, Okechukwu, 1998). TMB 3.3.2 has reinforced this.

Yeast alcohol metabolism, yeast alcohol and aldehyde dehydrogenases were susceptible to the antioxidant properties of bergenin isolated from the bark extract (Ekong and Ejike, 1974) and the crude extract (Okechukwu, 1998). A non-competitive inhibition of yeast alcohol and aldehyde dehydrogenases was obtained (Okechukwu, 1998). TMB data do not substantiate bergenin as an antioxidant because it inhibits alcohol or aldehyde dehydrogenases but on the criterion of its being free hydroxyl (·OH) scavenger.

Madusolumuo (1993): bark treatment in mammalian system pretreatment protected the rat liver against acetaminophen-induced cytotoxicity. This is reminiscent of 2 to 3 in scheme 1 and 9 to 3 in scheme 2. Because of the reactions ,there will be no room for N – acetylation (Akintonwa 1995). Because of the generation of ·OH in scheme 2, the extract should be capable of scavenging the ·OH (hydroxyl radical).

Sacoglottis gabonensis stem bark extract on the natural antioxidant defences during 2,4 DNPH - induced membrance peroxidation in vivo (Maduka and Okoye, 2002). To what extent TMB data are consistent with experimental data will hitherto be investigated (Akintonwa, 1995).

Three – day bark drinking water extreme administration to male weaning rats plus a single intraperitoneal (1/P) administration of 2,4 – DNPH. Liver and red blood cells were examined for the “three primary antioxidant enzymes” (catalase, superoxide dismutase (SOD) and glutathione peroxidase) and vitamin E ( – tocopherol) and vitamin C

(ascorbic acid) levels.

Superoxide dismutase (SOD), catalase, glutathione peoxidase and reductase (NADPH dependent) and  – tocopherol (vitamin E) are body compensatory or defence mechanisms normally available to counter the free – radical complications (Akintonwa, 1986). The 2,4 – DNPH administered should generate ·OH by the TMB of scheme 2.

The bark extract, from the structure of bergenin with 4 - ·OH substitute, should be capable of scavenging the free hydroxyl) radical, ·OH as shown in 2.1. Similarly, the vitamin E and vitamin C should also be capable of scavenging the ·OH.

The bark extract should not exhibit ‘‘divergent effects on natural antioxidant enzymes.’‘ It should not perse affect the enzymes by TMB. it is the ·OH from 2,4 – DPNH that can affect the enzymes according to TMB 3.3.1.

By TMB 2,4 – DNPH should have a measurable effect on glutathione peroxidase because of ·OH generated. The bergenin extract should have no effect on glutathione peroxidase. But when the two are in consonance, the ·OH will now be scaveged by the extract concomitantly with no effect on glutathione peroxidase.

The bark extract by TMB should reinforce or overwhelm the antioxidants: Vitamin E and vitamin C. Hence the effective inhibition of depletion by “2, 4 –DNPH or ethanol in the liver” obtained experimentally.

## CONCLUSIONS

The conclusion ,therefore, reached by TMB: 2.1, 2.2, 3.3, 3.4, 3.4.4.4 and 3.4.4.5 is that it is the effect of the bark extract on the scavenging of ·OH of 2, 4 – DPNH which is the dominating factor. This TMB conclusion is at variance with the experimentally derived conclusion that the “mechanism of antioxidant action of the bark extract against membrane peroxidation is multifactorial / multisystem, involving inhibition of catalase, enhancing the SOD capability of the liver and red blood cells and sparing tissue depletion / utilization of vitamins C (ascorbic acid) and vitamin E ( - tocopherol)” (Maduka and Okoye 2002). The ·OH is produced during the oxidation of GSH and other thiols by $H_2O_2$, the reaction is catalyzed by copper and iron complexes and flavoproteins, the presence of oxygen or the superoxide not being required (Florence, 1984). The involvement of SOD is therefore not required. Using the oxidation reduction electron method GSH (reduced glutathione) and copper complex ($Cu^{2+}$) will yield GSSG (oxidized glutathione) (Akintonwa, 1986).

## CORRESPONDENCE TO

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