

REVIEW OF NORMOMETABOLIC EXCELLENT ANTIOXIDANT FROM RAW TEMPEH TO PREVENT ATHEROSCLEROSIS

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ABSTRACT

Atherosclerosis is a major risk factor for various degenerative diseases in the world, such as coronary heart disease, stroke, high blood pressure, and others. Atherosclerosis occurs because the body lacks antioxidants which act as anti-atherogenic. Fresh tempeh contains many excellent antioxidants which plays a very good anti-atherogenic role, and high isoflavones as daidzein isoflavones, glycitein isoflavones, and genistein isoflavones, and especially Factor II isoflavones (6,7,4 trihidroksi isoflavon), which have the strongest antioxidant properties.

Keywords : Atherosclerosis, Raw tempeh, Excellent antioxidant, Normometabolic

INTRODUCTION

Atherosclerotic plaque is the main cause of coronary heart disease in the world, in Indonesia there is an increasing trend. This happens because of the continuous intake of foods with high cholesterol content. Dyslipidemia is a major risk factor for atherosclerosis. Oxidative stress can only be controlled by intake of antioxidants from food, which in turn will stimulate the work of antioxidants in the body. Cellular antioxidants cannot work individually without the support of intake of various secondary antioxidants from foodstuffs (Agung, 2013).

Considering that the treatment of atherosclerotic patients requires a long time, and requires a long time, and requires high costs, research continues to be developed, including using functional foods, which are more effective at lower prices, and reduce the side effects caused. One of the functional foods that can be used as anti-atherogenic in the long term is the use of natural ingredients such as regular consumption of fresh tempeh, no side effects. Because fresh tempeh contains quite a high amount of excellent antioxidants, such as isoflavones, proteins, vitamins and minerals (Susianto, 2013). Therefore, this paper will review how excellent antioxidants, as anti-atherogenic, are contained in fresh tempeh.

ANTIOXIDANT AS AN ANTI-ATEROGENIC

Antioxidants are compounds that can inhibit or prevent oxidation of substrates by scavenging or repairing damage caused by free radicals (Sies *et al.*, 2005). In a chemical sense, antioxidant compounds are electron donors or reductant, shown in Figure 1.

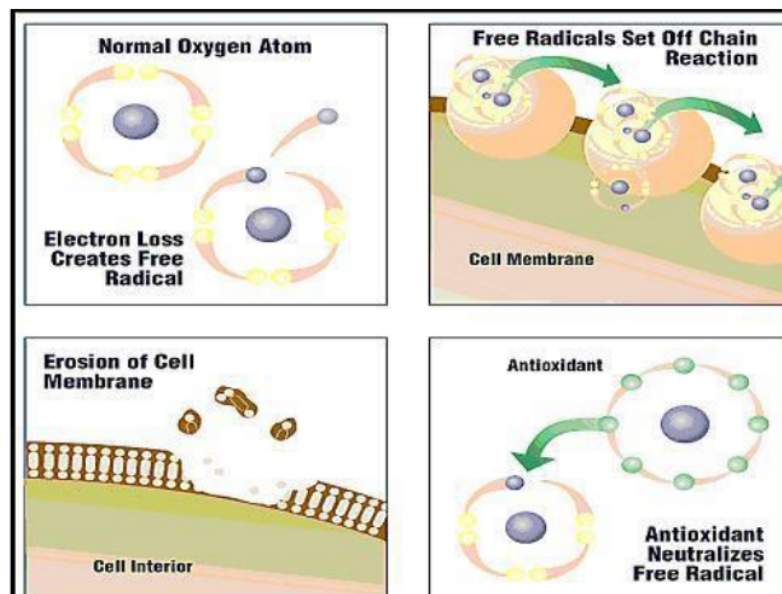


Figure 1 Mechanism of Electron Donation by Antioxidant Compounds in Neutralizing Atherosclerosis (Craig, 2005)

Antioxidants as antiatherogenic as follows (Youngson, 2005):

- (1) Reducing Ox-LDL cytotoxicity. Ox-LDL has cytotoxic properties because it can cause endothelial and macrophage necrosis. Proteolytic enzymes such as matrix metalloproteinases released by macrophages can reduce the structural integrity of the fibrous cap lining atherosclerotic lesions, followed by unstable and easily ruptured vascular lesions/plaques. Antioxidants have a role to increase the stability of atherosclerotic plaques and prevent thrombosis.
- (2) Preventing inactivation of nitric oxide (NO) in endothelial cells.

Endothelium-derived NO (EDNO) is a key molecule for the regulation of vascular tone and homeostasis. EDNO has a broad role, including: (a) regulation of vascular tone, especially a vasodilator, (b) potent anti-atherogenic activity including inhibition of VSMC proliferation, platelet aggregation and leukocyte-endothelial interactions. EDNO is synthesized from L-arginine by the enzyme NADPH-dependent NO synthase (NOS) in both constitutive and inducible isoforms. Ox-LDL can inhibit the synthesis and release of EDNO and also directly inactivates EDNO. Peroxide anion radicals ($O_2^{\bullet-}$) can interact followed by the absence of the EDNO function.

EXCELLENT ANTIOXIDANTS IN TEMPEH

Excellent antioxidants in tempeh are isoflavones namely secondary metabolites consisting of 19 groups of aglycone compounds (in a free state or not bound to other compounds) and six glycoside groups (binding to other compounds). The main constituent of isoflavonoids is the same, namely 15 carbon atoms with the arrangement as C6-C3-C6. Soobrattee *et al.* (2005) reported that soybeans contain three types of isoflavones, namely daidzein, glycitein, and genistein. In tempeh, in addition to the three types of isoflavones, there is also factor II antioxidant (6,7,4-trihydroxy isoflavone) which has the strongest antioxidant properties. These antioxidants are synthesized during the process of making tempeh. Factor II, which is only found in tempeh, is proven to be produced by the bacteria *Micrococcus luteus*, *Microbacterium arborescens* and *Brevibacterium epidermis* (Papendorf and Barz, 1991). The process of formation of Factor II can occur through two reactions, namely (1) through demethylation of glycitein by *Micrococcus luteus* and *Brevibacterium epidermis* bacteria, and (2) through hydroxylation of daidzein by *Microbacterium arborescens* bacteria (Figure 2).

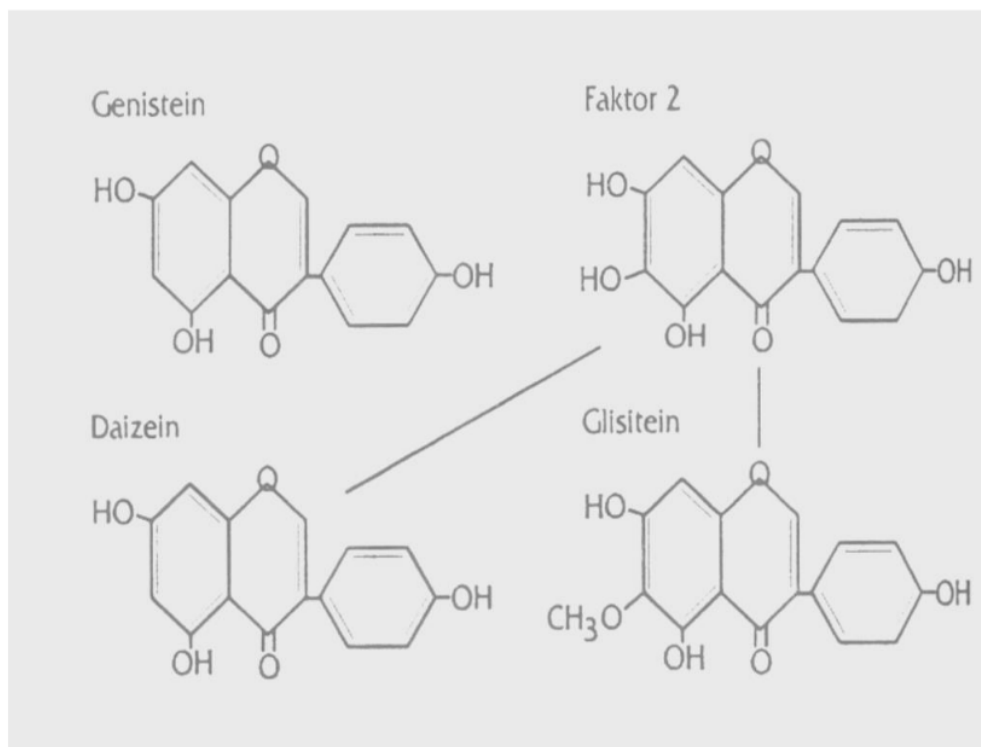


Figure 2 Biosynthesis Factor II (6,7,4-trihydroxy isoflavone) (Papendorf and Barz, 1991)

Genistin is an isoflavone found in tempeh which is believed to be able to inhibit the action of enzymes that stimulate the development and movement of cells, so that genistin can prevent the development of cells that form plaque in the arteries (Mindell, 2008). Flavonoid compounds can replace vitamin E. The antioxidant activity of flavonoids depends on their molecular structure, especially the prenyl group (CH₃)₂C=CH-CH₂. Research shows that the prenyl group of flavonoids was developed for the prevention or therapy of diseases associated with free radicals (Sofia, 2005). Tempe is a food ingredient that contains isoflavones, which are active substances that have a structure and function similar to estrogen, known as phytoestrogens. Consuming tempeh which contains isoflavones continuously is believed to help lower cholesterol levels thereby minimizing the occurrence of heart disease due to inhibition of the formation of atheroma plaques in blood vessels (Rahmad, 2009).

CONCLUSION

Fresh tempeh contains many excellent antioxidants which plays a very good anti-atherogenic role, and high isoflavones as daidzein isoflavones, glycitein isoflavones, and genistein isoflavones, and especially Factor II isoflavones (6,7,4 trihidroksi isoflavon), which have the strongest antioxidant properties.

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