

Antioxidant Defences: Food for Thoughts

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For the last 3 decades it has become clear that over-production of free radicals and oxidative stress are involved in the development of different human/animal diseases at various stages of their development. Therefore antioxidant defence system functioning in the cell/body has received a great deal of attention in recent publications. Indeed, there is a range of various molecules possessing antioxidant activities in the cell/body. Some of them are provided with diet (vitamin E, carotenoids, selenium, etc.), others (AO enzymes, glutathione (GSH), thioredoxin, heat shock proteins (HSP), etc.) are synthesised in the cell/body and they build effective antioxidant defences. When considering antioxidant system functioning, one should take into account possible interactions between different antioxidants. In fact, vitamin E, the major antioxidant in biological systems responsible for prevention of lipid peroxidation, together with coenzyme Q, the only fat-soluble antioxidant synthesised in the body, can be called “head quarter” of the antioxidant system. Carotenoids, comprising a group of pigments accounting for more than 750 compounds and in many cases affecting gap junction in the cell can be called “communicating services” of the antioxidant defence. A group of polyphenols includes more than 8,000 various natural compounds can be called “antioxidant police”, since most likely they do not act as direct antioxidants, but rather affect transcription factors and other molecular pathways responsible for improvement of antioxidant defence. Vitamin C, carnitine, betaine and taurine are able to be synthesised in chicken/farm animals, however, in stress conditions as well as in early postnatal development the synthesis very often could not be adequate to meet requirements in these antioxidant-relating molecules. Therefore, this group of antioxidants can be included into “special forces” category. Indeed, their supplementation, especially via drinking water could be an effective way fighting commercially-relevant stresses in poultry/livestock production. Antioxidant enzymes, such as superoxide dismutase (SOD), catalase, methionine sulfoxide reductase B and heat shock proteins (HSP) can be called “land troops” of antioxidant defence, since they represent main AO forces at the front line of free radical formation. In fact, GSH, thioredoxins/thioredoxin reductase and peroxiredoxins participating in stress sensing and providing important forces of AO defence, could be called “FBI”. Such important molecules as sirtuins and transcription factors (Nrf2 and Nf-kB) providing

When characterising antioxidant properties of Se, one has to take into account that in animals, including poultry, and humans Se in the form SeCys acts as an essential part of 25 selenoproteins which are located in different parts of the cell, expressed in different tissues and their expression depends on stress-conditions and Se availability. For example, GSH-Px, the most widely studied selenoprotein in animal tissues, is found in 4 different forms. Traditional GSH-Px is located in cell cytosol, while phospholipid-hydroperoxide GSH-Px (PH-GSH-Px) is located in membranes and can directly detoxify hydroperoxides formed during peroxide-radical detoxification by vitamin E. Furthermore, gastro-intestinal GSH-Px (GI-GSH-Px) is a major AO in the gut maintaining its integrity, preventing peroxide absorption from the diet and affecting gut inflammation. Indeed, recent studies clearly have indicated that Se deficiency is associated with gut inflammation [2,3]. In addition, there is plasma GSH-Px (pGSH-Px) which is also an important antioxidant. It has been suggested that more than half of the selenoproteins directly or indirectly participate in antioxidant defences and maintaining redox balance of the cell [4]. Therefore, Se can be called “chief executive” of antioxidant defence. Since Se efficacy depends on its dietary form animal/poultry industry is looking for the most effective organic Se sources and it seems likely that recently appeared on the market OH-SeMet could be considered as a Se supplement of the new generation, combining advantages of other Se sources, including Se-Yeast and pure SeMet [5].

At the centre of the antioxidant system is so called “ministry of defence” represented by vitagene expression. Indeed, vitagenes are shown to be main elements in adaptation to stress and they represent an important regulatory link between all antioxidants in the cell/body [6]. It seems likely that vitagenes in the gut are interacting with microbiota and this subject await further investigation. Indeed, more research is needed to understand how regulation of vitagenes can help dealing with commercially-relevant stresses in animal/poultry production as well as in maintaining human health.

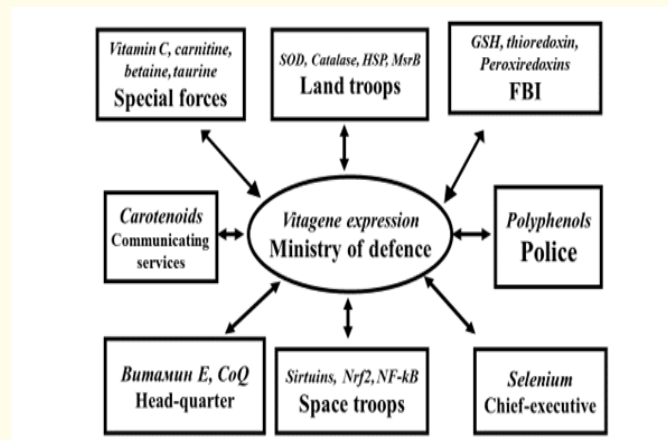


Figure 1: Antioxidant system of the body.

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