

the metabolism. A reduction in hydroxylamine production could be controlled by intravenous injection of hydroxylamine solution. No data is available for the effects of the injection of dilute aqueous solutions of pure hydroxylamine. The salts of this compound (chloride, sulphate) are described as moderately toxic (mouse, lethal dose 408 mg/kg of body weight). Enhanced metabolic production of hydroxylamine is possible using sildenafil. However, the muscle stimulant action of this compound could be counterproductive in some instances where cardiac function is affected and in addition the compound contains the benzene nucleus. Alternative sulphite and nitrite carriers without the benzene nucleus are preferred. Deficiencies in glycoaldehyde and methanol are controllable by direct intake of these compounds.

Compounds for treatment of the condition by transfer into the metabolism through the digestive system must survive the chemical conditions in this organ. Proteins and enzymes are frequently linked to polyphosphoric acids (phosphoproteins, casein, vitellin, chymosin), as are phosphatides (lecithin). Enzymes like chymosin are stable in the stomach. A mode of transfer of the active compounds into the metabolism is the use of enzyme or protein carriers in place of benzene nucleus carriers. Polyphosphoric acids react with hydrogen peroxide to give peroxyphosphoric acid (H_3PO_5) and peroxydiphosphoric acid ($H_4P_2O_8$). These two acids convert from one to the other in aqueous solution according to the pH of the solution. Peroxyphosphoric acid predominates in acid solution and peroxydiphosphoric acid predominates in alkaline solution. These compounds are possible sources of enhanced

hydrogen peroxide in the metabolism. Hydroxylamine forms hydroxylamine phosphate with monophosphate ion $[(NH_3OH)_3PO_4]$. Similar linkage is possible for sulphite ions through thiophosphoric acids, monothiophosphoric acid (H_3PSO_3) and dithiophosphoric acid ($H_3PS_2O_2$) and trithiophosphoric acid (H_3PS_3O). It is proposed that proteins and enzymes can be modified to form complexes containing polyphosphoric acid along with hydrogen peroxide, hydroxylamine or sulphite groups which can be used to transfer the required active compounds into the granular cells of the brain with the possibility of giving relief from the effects of Alzheimer's disease.

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Immunomodulation, allohormones and fertility

Dear Editor,

Bazar et al. [1] reported that catecholamines present in the semen influence female immune response, and may represent a strategy to increase sperm survival. In relation to this idea, there are two issues that I want to address here. Firstly, the type of bioactive

substances discussed in the above mentioned paper fall within a class referred to as allohormones [2,3]. Secondly, by combining their results with findings from fundamental biological research the authors provide essential insight into fertility problems faced in reproductive medicine. In the following, I will briefly elaborate on both these issues.

As Bazar et al. [1] rightly stated, it is not uncommon for substances that are transferred into the mating partner (via semen or otherwise) to influence the outcome of fertilization [4]. As a matter of fact, the biological literature focusing on sexual selection is riddled with such examples [5], some of which are quite extreme [6]. Obviously, sexual selection favours the transfer of bioactive substances that enhance the chances of the sperm fertilizing the partner's eggs. This selective force is particularly strong in species where semen (sperm and seminal fluid) is costly to produce and sperm competition is fierce, because in such cases fertilization is not assured [7].

Bioactive substances that influence the fate of sperm after transfer can help to ensure paternity. Because such substances are transferred between individuals of the same species, and act directly on the physiology or behaviour without the involvement of sensory organs, they have been defined as allohormones [2,3]. Given their immunomodulatory effect in the female, catecholamines that are transferred via the semen should also be seen as allohormones.

Fertility in humans, and especially lack thereof, is a recurring problem in reproductive medicine. However, such problems may become much more understandable when they are put into a broader scientific framework, as has been brought forward by several researchers [1,4,8]. Although the necessity of immunomodulation of the human female reproductive tract may seem puzzling, in evolutionary terms this makes perfect sense. As already alluded to in the above, males of promiscuous species are usually interested in maximizing their paternity, while females want to optimize the quality of their offspring. Evidently, these two interests will often not coincide, resulting in sexual conflict [5,8]. Especially in the case of lowered immune response in the female, the cost for the female is high due to the increased risk of infection [9]. Hence, such a conflict may lead to counter-adaptation by the female, which can then result in an arms race between immunomodulating seminal products and hostile female reproductive tracts.

In conclusion, catecholamines could be one of many seminal products (such as prostaglandins

[4]) that have an allohormonal function within the female reproductive tract. Additionally, linking knowledge of fundamental and applied research clearly benefits the issue of fertility, which is relevant for animal breeding programs as well as human reproduction. And, the overlap between the different fields illustrates that for a full understanding of reproductive processes, fundamental research is as important as applied research.

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