

## **OLD MICE IMPROVE THEIR NERVOUS AND IMMUNE FUNCTIONS AFTER BATH THERAPY WITH SULPHUROUS MINERAL WATER**

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**Keywords:** Sulphurous water, Hydrogen sulphide, Aging, Medical Hydrology, Thermalism, Balneotherapy, Nervous system functions, Immunity

### **Introduction and Aim**

Hydrogen sulphide, generated endogenously in mammalian tissues, is a synaptic modulator and neuro protector in the brain increasing the levels of glutathione, a major cellular antioxidant. The role of hydrogen sulphide in inflammation is controversial and complex showing pre inflammatory and anti inflammatory effects depending on its concentrations and the donor used. Besides that endogenous production of hydrogen sulphide, it is known that thermal waters rich in sulphur are exogenous sources of

this molecule, and they have been traditionally used in bath therapies because of their beneficial effects on human health. As the ageing process is a chronic oxidative stress situation with a decrease of glutathione levels and a nervous and immune systems deterioration, the objective of the present work was to investigate in old mice the role of baths with sulphurous thermal waters in several nervous and immune functions as well as glutathione leukocyte levels.

## Design and Methods

Twenty months old female ICR-CD1 mice were used. They were divided in three groups: the first was submitted a daily bath of 15 minutes in sulphurous water (called "sulphurous water group", SWG), the second in normal water (called "control water group", CWG), and the third was maintained in the cage ("control sedentary group", CSG). The treatments were performed during two weeks, five days per week. Neuromuscular coordination was analyzed through the tightrope test, and the exploratory and anxiety-like behaviours by open field, holeboard and T-maze tests. In addition, peritoneal leukocytes were obtained and macrophage phagocytosis, digestion capacity (intracellular reactive species (ROS) levels), natural killer (NK) activity against tumour cells and total GSH levels, determined.

## Results

The results show that the neuromuscular vigour and exploratory capacities are improved and anxiety reduced in animals of SWG with respect those in CSG, and in some parameters they are better than mice of CWG. The GSH levels were higher in

leukocytes from SWG than in the other groups. The phagocytosis was also higher in macrophages from SWG than from CWG and in the animals of this group than those of CSG. The NK activity was higher in leukocytes from SWG and CWG with respect to those of CSG.

## Conclusions

Bath sessions in thermal water rich in sulphur compounds improve several nervous system functions and peritoneal cell activities as well as the redox state of these cells in old mice. Since the immune parameters studied, which show an age-related deterioration, are markers of biological age and longevity, this improvement suggests that the bath treatment is a good strategy to slow down the ageing process and reach a healthy longevity.

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## INTRODUCTION AND AIM

Hydrogen sulphide (H<sub>2</sub>S), generated endogenously in mammalian tissues, is a synaptic modulator and neuro-protector in the brain increasing the levels of glutathione (GSH), a major cellular antioxidant. The role of H<sub>2</sub>S in inflammation is controversial and complex showing pro-inflammatory or anti-inflammatory effects depending on its concentrations and the donor used. Besides that endogenous production of H<sub>2</sub>S, it is known that thermal waters rich in sulphur are exogenous sources of this molecule, and they have been traditionally used in bath therapies because of their beneficial effects on human health. As the ageing process is a chronic oxidative stress situation with a decrease of GSH levels and a nervous and immune systems deterioration, the objective of the present work was to investigate in old mice the role of baths with sulphurous thermal waters in several nervous and immune functions as well as GSH leukocyte levels.

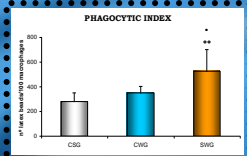
## DESIGN AND METHODS

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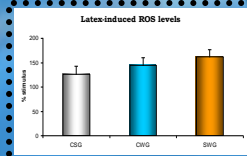


## RESULTS

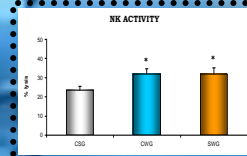
### MACROPHAGE FUNCTIONS



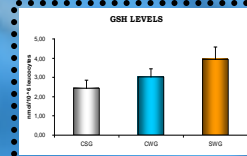
### ROS LEVELS



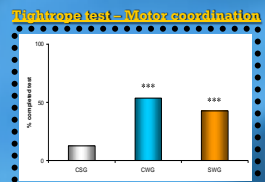
### NK ACTIVITY



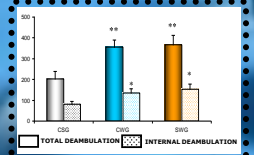
### GSH LEVELS



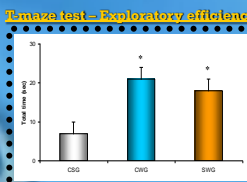
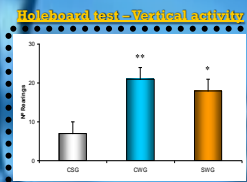
### SENSORIMOTOR ABILITIES



### Open field test – Horizontal activity



### EXPLORATORY AND ANXIETY-LIKE BEHAVIORS



CONTROL SEDENTARY GROUP, CSG      CONTROL WATER GROUP, CWG      SULPHURE WATER GROUP, SWG

\*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$  with respect to CSG. •  $p < 0.05$  with respect to CWG.

## CONCLUSIONS

Bath sessions in thermal water rich in sulphur compounds improve several nervous system functions and peritoneal cell activities as well as the redox state of these cells in old mice. Since the immune parameters studied, which show an age-related deterioration, are markers of biological age and longevity, this improvement suggests that the bath treatment is a good strategy to slow down the ageing process and reach a healthy longevity.