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Carcinogenicity of red meat: the genotoxic and mutagenic potential of nitrosyl heme

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Question

Epidemiological studies infer that a high consumption of red meat is a factor driving intestinal carcinogenesis. Processing of meat through the addition of nitrite leads to the formation of nitrosyl heme (NO-heme), which might induce gene mutations and thus play a role in colorectal tumor formation. NO-heme is not commercially available and all synthesis methods described so far yield a mixture containing toxic byproducts. Therefore, the aim of the present study was to generate pure NO-heme and determine potential genotoxic and mutagenic effects using various *in vitro* approaches.

Methods

NO-heme was firstly synthesized using a previously published protocol, followed by additional purification steps such as dialysis and centrifugal vacuum concentration. Then, the resulting purified compound was detected, quantified and characterized by UV-vis and FTIR spectroscopy.

Results

During synthesis, the concentration of mutagenic nitrite in NO-heme solutions could be reduced by a thousand-fold. When exposed to light and ambient air for two hours, pure NO-heme decomposes to yield hemozoin and nitrogen dioxide. Nevertheless, it can be stored over months at -80 °C protected from air and light. Preliminary data show significant DNA-damaging and mutagenic effects caused by the NO-heme treatment of Caco-2 and CHO-K1 cells.

Conclusion

A new method for NO-heme purification was established and analytically verified. For the first time, pure NO-heme was investigated regarding its toxic potential, with preliminary data suggesting DNA-damaging and mutagenic effects emanating from this compound. This might constitute a possible explanation for the link between processed red meat and colorectal cancer.

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