What are the risks of nitrite NO2 and nitrate NO3 exposure of consumer eating pork processed food?

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Introduction: Nitrite and nitrate salts are commonly used to preserve meat. NO3 are naturally present in some vegetables. NO3 can enter the food chain as an environmental contaminant in water, therefore contributing to the exposure of people.

Among the existing processes for pork processed meat, dry fermented sausage and cooked ham were chosen. Reducing nitrites and nitrates in new formulation raises the challenge of maintaining the safety and organoleptic quality.

Recently, EFSA has re-evaluated the safety of NaNO2 and NaNO3 as Acceptable Daily Intakes (ADIs): 0.07 mgNaNO2/kg bw/day and 3.7 mg NaNO3/kg bw/day. This initiative goes hand in hand with ongoing research by manufacturers to reduce nitrites and NO3 inputs to processed meat. The objective is the evaluation of NO2 and NO3 exposure induced by dry fermented sausage and cooked ham consumption with different formulations.

Materials and methods: Dry fermented sausages were manufactured by ADIV (meat technical center), with different formulations 0 ppm NO2/NO3, 80 ppm NO2/NO3, 200 ppm of NO3 (200 NO3), 120 ppmNO2/ NO3). Cooked ham was manufactured by IFIP (meat tecnical center) with brine containing 0, 40, 80 and 120 ppm of NO2, and ascorbate (300ppm).

Nitrite and nitrate ion contents were determined using the procedure of Bonifacie et al. (2021).

Nitrite and nitrate exposure calculations according to body weight: the calculation is based on NO2 and NO3 residual content of the product. For dry fermented sausage an intake mean of 7.5g was used, for cooked ham 40g for adult and for an infant (1 y-old, 10kg) 10g. All these quantities were detemined using the French annual consumption for dry fermented sausage, the weight of a cooked ham slice marketed and infant recommendation.

Results: The residual content (RC) of NO2 and NO3 in dry and cured sausage with 0/0 ppm NO2/NO3 was 0.17 for NO2 and 4.19 for NO3. For 80/80 ppm NO2/NO3, the RC of NO2 and NO3 was 3.6 for NO2 and 6.8 for NO3. For 0/120 ppm NO2/NO3, the RC of NO2 and NO3 was 4.4 for NO2 and 13.1 for NO3. For 120/120 ppm NO2/NO3, the RC of NO2 and NO3 was 8.4 for NO2 and 21.3 for NO3. For residual NO2, the formulation 80/80ppm did not differ from 0/120.

The residual content (RC) of NO2/NO3 in cooked ham with 0 ppm NO2 was 0 for NO2 and 45 for NO3. For 40 ppm NO2, the RC of NO2/NO3 was 7.7/61. For 80 ppm NO2, the RC of NO2/NO3 18/47. For 120 ppm NO2, the RC of NO2 and NO3 wasn34/120. Residual nitrate in cooked ham only differed for 120ppm.

Exposures: The calculation of NO2 and nitrate exposition when consuming dry and cured sausage is based on a daily portion of 7.5g (French data). For NO2, the ADI remains below 2% for the formulation with 120 NO2/120NO3, for a body weight comprised between 50 and 80kg. In the same line, the exposition to NO3 is under 0.1%. The calculation of NO2 and NO3 exposition when consuming cooked ham is based on a daily portion of 40 g slice. For NO2, the ADI remains below 40%, for the formulation with the maximum of NO2 (120 ppm). Interestingly, decreasing the NO2 addition by 1/3 in the formulation of cooked ham would reduce by 2 the exposition for a body weight comprised between 50 and 80kg. The exposition to NO3 due to cooked ham ingestion is under 3%. For infant, NO2 and NO3 exposition is less than 10% of ADI for NO2 and 1% for NO3

Conclusion: It is clearly established that the risk of NO2 and NO3 exposure remained far from the ADI. Moreover, it is possible to decrease this risk by formulation using less NO2 and/ NO3. Neither NO3 nor NO2 per se is the active inhibitory principle for pathogens, they have to be converted to reactive intermediate compounds such as NO°, N2O3, ONOO-, NO2°, RS-NO. Substantial effort in research must be made on the reactivity of the above compounds in the products and during digestion.