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Preservatives and risk of cancer

Potential carcinogenic effects of preservative food additives require further validation

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Preservative food additives are extensively used in the modern food industry to extend shelf life by inhibiting microbial growth and slowing chemical changes that lead to spoilage.[1] Growing concerns have emerged about the potential health effects of some preservatives. For example, experimental studies have shown that nitrates and nitrites (preservatives added to processed meats) can be converted endogenously to N-nitroso compounds—proven carcinogens in animals and potential carcinogens in humans.[2] Recognizing the risks, the European Food Safety Authority has established acceptable daily intake levels for nitrates and nitrites.[3] However, epidemiological evidence linking preservative additives to cancer risk remains scarce, largely because of limited data on the specific industrial food products consumed and the considerable variation in additive levels across brands.

In this context, Hasenböhler and colleagues (doi:10.1136/bmj-2025-084917) comprehensively examined the association between exposure to preservative food additives and the risk of cancer in a linked study among 105 260 adults in NutriNet-Santé, a large prospective cohort study in France.[4] Total intake of non-antioxidant preservatives was associated with a modestly increased risk of overall cancer (hazard ratio of 1.16 comparing highest versus lowest sex specific thirds of consumption). A major strength of this study was its detailed assessment of preservative intake, through repeated 24 hour dietary records linked dynamically to food composition databases and supplemented by ad hoc laboratory assays. Adjustment for nutritional profiles, preservatives from natural sources, and other food additives associated with cancer[5,6] enabled a clearer assessment of the independent association of preservative additives. However, given the modest increased risk estimates, causality cannot be established and unmeasured or residual confounding cannot be ruled out, especially considering the strong correlations between some preservatives and their food vectors. For example, nitrites and nitrates were consumed mainly through processed meats, whereas sulfites were consumed predominantly from alcoholic beverages—both classified as carcinogenic to humans.[7,8] It is uncertain to what extent the observed associations (hazard ratio 1.32 between sodium nitrite and prostate cancer, 1.22 between potassium nitrate and breast cancer) may be attributed to other constituents and metabolites of processed meat (eg, heterocyclic amines and polycyclic aromatic hydrocarbons) and alcohol beverages (eg, acetaldehyde) implicated in carcinogenesis.[9-11]

Rising consumer demand for "more natural" preservation methods has driven a shift from artificial towards natural alternatives.[1] In Hasenböhler and colleagues' study, the natural preservatives assessed were limited to a few compounds: plant derived (eg, rosemary extract), animal derived (eg, lysozyme), and microorganism derived (eg, nisin). The authors reported an inverse association between rosemary extract and colorectal cancer, although based on limited cases. A prior analysis of the same database[12] found that only nitrite and nitrate additives were associated with cancer risk, with no associations observed for total nitrite or nitrate intake or for intakes from natural sources. The authors hypothesized that the high antioxidant content of vegetables may reduce the carcinogenic potential of naturally occurring nitrites and nitrates. It remains unclear whether synthetic preservatives are more harmful than natural ones.

Hasenböhler and colleagues' study was constrained by limited statistical power for certain site specific cancers, such as colorectal cancer. Future research priorities include conducting larger and longer term prospective studies in diverse populations; randomized trials exploring dietary modifications, such as manipulating the intake of preservatives; and mechanistic investigations to elucidate the biological pathways through which potential risks may arise. A promising direction is to integrate multi-omics approaches such as the metabolome[13] and microbiome[14,15] with traditional dietary assessments to identify sensitive and specific biomarkers of preservative intakes.[16] Moreover, because various additives and food chemicals often coexist in processed foods, further epidemiological and experimental studies are needed to elucidate the combined and interactive effects of preservatives with other chemical components.

From a policy perspective, preservatives offer clear benefits by extending shelf life and lowering food costs, which can be particularly important for populations with lower incomes. However, the widespread and often insufficiently monitored use of these additives, with uncertainties of their long term health effects, call for a more balanced approach. Currently, the US Food and Drug Administration evaluates the premarket safety of food additives, but a formal approach for reviewing food additives already present in the food supply is lacking.[17] Findings from NutriNet-Santé may prompt regulatory agencies to revisit existing policies, such as setting stricter limits on use, requiring clearer labeling, and mandating disclosure of additive contents. Furthermore, collaborative global monitoring initiatives, similar to those implemented for trans fatty acids and sodium, could also support evidence based risk assessments and guide reformulation by the food industry.[18,19] At the

individual level, public health guidance is already more definitive about the reduction of processed meat and alcohol intake, offering actionable steps even as evidence on the carcinogenic effects of preservatives is evolving.

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