EFFECTS OF MODIFIED ATMOSPHERES AND FUMIGATION ON MICROBIAL DEVELOPMENT IN GRAIN

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Colonisation of stored grain is determined by the interactions between water availability, temperature and intergranular gas composition but may be modified by fumigation or other chemical treatment. Fungi are usually considered to be aerobic but their requirement for oxygen is often overestimated while low concentrations of carbon dioxide can even be stimulatory to some fungi. *Aspergillus* and *Penicillium* species appear to be tolerant of very low oxygen concentrations, while carbon dioxide concentrations are small, and *P. roquefortii* can tolerate up to 75% CO_2 so long as there is adequate oxygen. However, CO_2 and O_2 concentrations interact so that increased CO2 concentrations are more inhibitory if O_2 is simultaneously decreased. This happens naturally in moist grain storage but not when CO_2 gas is added to stored grain. Modified atmospheres have usually been tested alone for their ability to prevent moulding of stored grain but interactions like those between CO_2 and O_2 also occur with water activity and temperature and with other physical and chemical treatments. If environmental, physical and chemical treatments can be integrated into a single management strategy, less extreme use of any one treatment may be possible. In laboratory experiments with a range of seed types, modified atmospheres containing 40 or 60% CO_2, both with 20% O_2, combined with irradiation (2 kGy) and propionic acid treatment (0.2%) prevented moulding better than any of the component treatments. Atmospheres with 10% CO_2 and 10% O_2 allowed more visible moulding than those with 15% CO_2 and 15% O_2 and additional treatment with 2-4 kGy and 0.01 or 0.02% butylated hydroxyanisole (BHA) completely inhibited moulding of the latter. Production of modified atmospheres in developing countries from waste materials using biogenerators has been shown to be feasible. Some grain fumigants are fungicidal as well as insecticidal but usually more is required than to kill insects. Even a concentration time product for methyl bromide of 4600mg.h/l was insufficient to give a total kill of fungi in sorghum while 380mg.h/l had no effect although the grain was killed. Phosphine at 3000-3500 mg/l over 90 days air was fungicidal to 89% of storage fungi and fungistatic to another 7%. Most of the resistant isolates were *Fusarium* spp. With 150 mg/l over 21 days, mycelial growth of *Aspergillus flavus* and aflatoxin production were both decreased.