Sugar-fermenting yeast as an organic source of carbon dioxide to attract the malaria mosquito Anopheles gambiae

Abstract:

Abstract Background Carbon dioxide (CO2) plays an important role in the host-seeking process of opportunistic, zoophilic and anthropophilic mosquito species and is, therefore, commonly added to mosquito sampling tools. The African malaria vector Anopheles gambiae sensu stricto is attracted to human volatiles augmented by CO2. This study investigated whether CO2, usually supplied from gas cylinders acquired from commercial industry, could be replaced by CO2 derived from fermenting yeast (yeast-produced CO2). Methods Trapping experiments were conducted in the laboratory, semi-field and field, with An. gambiae s.s. as the target species. MM-X traps were baited with volatiles produced by mixtures of yeast, sugar and water, prepared in 1.5, 5 or 25 L bottles. Catches were compared with traps baited with industrial CO2. The additional effect of human odours was also examined. In the laboratory and semi-field facility dual-choice experiments were conducted. The effect of traps baited with yeast-produced CO2 on the number of mosquitoes entering an African house was studied in the MalariaSphere. Carbon dioxide baited traps, placed outside human dwellings, were also tested in an African village setting. The laboratory and semi-field data were analysed by a χ2-test, the field data by GLM. In addition, CO2 concentrations produced by yeast-sugar solutions were measured over time. Results Traps baited with yeast-produced CO2 caught significantly more mosquitoes than unbaited traps (up to 34 h post mixing the ingredients) and also significantly more than traps baited with industrial CO2, both in the laboratory and semi-field. Adding yeast-produced CO2 to traps baited with human odour significantly increased trap catches. In the MalariaSphere, outdoor traps baited with yeast-produced or industrial CO2 + human odour reduced house entry of mosquitoes with a human host sleeping under a bed net indoors. Anopheles gambiae s.s. was not caught during the field trials. However, traps baited with yeast-produced CO2 caught similar numbers of Anopheles arabiensis as traps baited with industrial CO2. Addition of human odour increased trap catches. Conclusions Yeast-produced CO2 can effectively replace industrial CO2 for sampling of An. gambiae s.s.. This will significantly reduce costs and allow sustainable mass-application of odour-baited devices for mosquito sampling in remote areas.