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User-Inspired' UV-C Technologies to Control Microorganisms at Chilling Stations in Developing Countries

Due to increase in global temperatures, a lack of refrigeration makes a significant impact on dairy farmers in developing countries. Milk spoilage is huge concern, and it impacts farmers income. Conventional cooling and chilling are unaffordable for many farmers living in rural communities. A need for sustainable technologies is needed to control milk microflora at milk chilling stations. In this proof-of-concept study, the efficacy of UV-C irradiation to control total number of aerobic bacteria (SPC) in raw skim milk (RSM) was investigated. In addition, a bioassay was conducted to assess the UV-C inactivation of *Salmonella enterica* serovar Typhimurium (ATCC 700720) in syringe filtered (0.22 µm) RSM and quantification of reduction equivalent fluence. Optical properties of the RSM were measured using a double beam spectrophotometer connected to a single integrating sphere. Reduced scattering and absorption coefficients were mathematically calculated and accounted in the UV-C dose calculations. The absorption and reduced scattering coefficients were calculated as 12.58 ±0.8 cm^{-1} and 15.77 ± 1.04 cm^{-1}. 2 ml (6 mm fluid thickness) of RSM was irradiated using collimated beam device equipped with a low-pressure mercury lamp (12 Watts) emitting UV-C at 254 nm wavelength under stirred conditions. A series of known UV-C doses (0, 20, 40 $mJ \cdot cm^{-2}$) were delivered to the samples in triplicates followed by double platting and enumeration. Total number of aerobic bacteria in RSM was approximately 3.5 $\log_{10}$ $cfu.ml^{-1}$. 20 $mJ.cm^{-2}$ of UV exposure reduced the total aerobic counts by 1.5 $\log_{10}$ cycles. At the highest dose of 40$mJ \cdot cm^{-2}$, our results showed that UV-C irradiation completely inactivated total number of aerobic bacteria in RSM. This study demonstrated that initial microflora in RSM can reduced or eliminated using UV-C technology. UV-C technology can effectively control the microbial growth in milk at chilling stations, reducing spoilage. This will further improve the final quality of pasteurized milk in developing countries.