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PARTICLE SIZE ANALYSIS OF NEBULISED AEROSOLS USING FRAUNHOFER LASER DIFFRACTION AND INERTIAL COMPACTION METHODS

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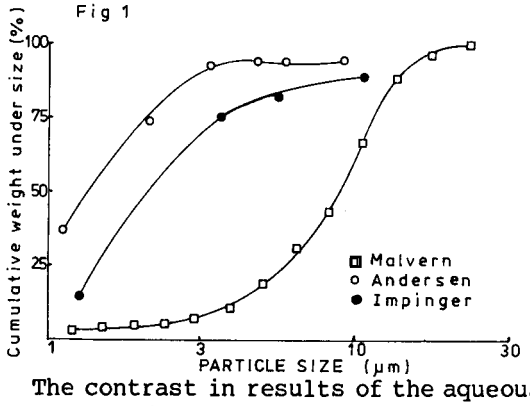
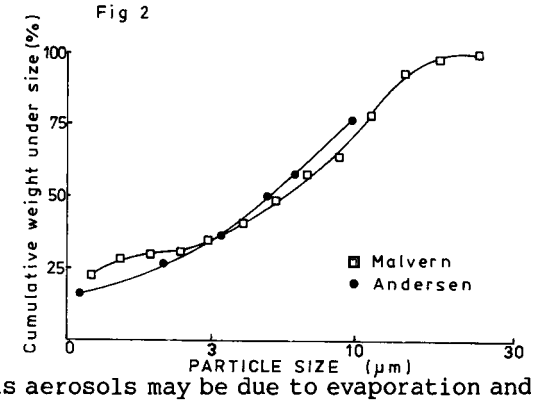
Nebulisation therapy is well established in both hospital and domiciliary environments, the efficacy of which is dependent upon aerosol deposition. Brain et al(1979) have described the major factors of depositon including particle size distribution of aerosol clouds. Microscopy(BPC 1973) is the existing standard method for sizing medicinal aerosols but it has its limitations; it is static, limited by depth of field, by overlapping of particles and by deformation of particles on impaction. The current study was carried out to examine the suitability of two techniques for sizing aqueous nebulised aerosols.

The nebulised clouds of a 5%w/v salbutamol solution emitted from a Venturi nebuliser(Hudson) operating at 4 l/min of compressed air were examined by cascade impaction(Andersen aerosol sampler) and Laser light diffraction(Malvern 2600HSD). The size distributions obtained using the two instruments are illustrated in figure 1. The large variation in results required further investigation.

For cascade impaction, the aerosol particles were drawn into the sampler by negative pressure (28.3 l/min) which may permit evaporation of aqueous aerosol droplets before impaction. Furthermore, larger droplets may rebound and lead to entrainment of smaller droplets onto the lower stages of the impactor. To investigate the possibility of aerosol evaporation during cascade sampling, a non-volatile oil, isopropyl myristate with 0.2%w/v Sudan IV as a marker, was nebulised and studied employing the above methods. The comparable aerosol size distributions are shown in figure 2. A multi-stage liquid impinger (MLI) samples aerosol clouds in much the same way as an Andersen impactor, however, re-entrainment of particles on impact is minimal. The aqueous aerosol cloud was re-examined using an MLI at 60 l/min, when an increase in size distribution was observed (figure 1) compared with the Andersen.





The contrast in results of the aqueous aerosols may be due to evaporation and re-entrainment of smaller particles in cascade impaction on dry plates as demonstrated in the latter experiments. The Malvern 2600HSD instantaneously sizes the aerosol clouds at a short distance (1cm) from the mouthpiece. Since aerosols are directly inhaled from the nebulised system, the Laser diffraction technique therefore provides more realistic particle size measurements for nebulised aqueous solutions.

Brain, J.D. et al (1979) Am. Rev. Resp. Dis. 120(6) 1325-1373