Table 44.5 Equipment for drying extracts

Type	Comments
Heated tray dryers	Deterioration due to long time in contact with heat, possible risk of oxidation of active constituents, labour intensive
Cabinet vacuum dryers	Oven temperatures 60–80 °C, heterogeneous drying, possible risk of oxidation of active constituents, labour intensive tray layout, uncertain endpoint
Drum/belt dryers	Evaporation provided by hot air stream, uncertain endpoint, possible risk of oxidation of active constituents, large scale possibilities, requires regranulation stage
Atomizers/spray dryers	Lower temperatures used, less time in contact with heat, cheaper than freeze drying, product in powder form, widely used
Freeze dryers	Low temperature, expensive to buy and operate, high quality product in layer form, requiring regranulation

either pharmacologically inactive, are active but possess additive, synergistic or even opposite or dissimilar activities. Ideally, these constituents should have been removed during primary production, but this is often unrealistic due to constraints of cost, lack of knowledge of their identities, and technical inability to remove them. Formulation with plant extracts requires a complete knowledge of the composition of the extract, so that the formulator can choose the most suitable excipients and formulation. Ideally, only one plant extract should be included in any formulation, but there are many examples where there are more than one. This may cause formulation problems due to interaction of components of one with the other, causing instability.

The problems associated with converting fresh or dried plant material into medicinal products are highlighted in the third column of Table 44.3. This lists the constraints to producing the best quality products. In addition to these general problems, there are additional problems relating to specific plants and their constituents.

Standardized extracts are essential in order to get as complete a list of constituents actually present in the extract (and hence) into the formulation. A number of these constituents are exceedingly unstable, e.g. valepotriates from Valerian, when in acidic or basic medium in combination with water. Turbidity of reconstituted solutions is a widespread problem, sometimes dealt with by incorporation of polyvinylpyrrolidone (PVP). Emulsions of particular extracts containing saponins (widespread in plant extracts) are often found to exhibit phase separation (Crippa, 1980)

Drying plant material inactivates endogenous enzymes, but extracts which contain glycosides are then subject to degradation when formulated into aqueous media, as the enzymes are re-activated.

The greatest risk to the quality of constituents is heating during manufacture, but the quality of water is also important. pH has a major effect on the stability of a number of types or formulations and their active constituents. Both acidic and basic conditions have been shown to have detrimental effects.

Variability of crude drug material

Supply of raw material is a major problem, due to wide-scale variations in composition. Published surveys show that there can be a distinct difference in constituent levels even between batches from the same supplier.

Adulteration (deliberate or accidental substitution with inferior material) has long been a problem with herbal remedies. Traditional QC procedures have been adopted to detect this situation, with a number of parameters specifically designed to identify the problem of adulteration with inferior material.

With the increased use of herbal remedies the causes may be more sophisticated, for example attempting to improve the characteristics of the extracts with material not detected using standard assays. Bilberry extracts have been found adulter-