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Efficient Method of Storage of Dry Herbs

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Herbs form the raw material for Ayurvedic medicinal products. Around 56,500 metric tons of medicinal herbs were exported from India during 2009-2010. The domestic traditional medicine industry consumes annually 177,000 metric tons of herbs. Additionally, 86,000 metric tons are used within Indian households. Therefore, the storage of herbs is an important subject.

Freshly dried herbs are very storage-sensitive products. Several factors are important in deciding the quality of dried and stored herbs. Because the dried herbs contain a large quantity of hydrophilic constituents like sugars, flavonoids, mucilage, choline and salts they are very hygroscopic products. Their moisture content can therefore, adopt the surrounding microclimatic conditions very quickly, absorbing moisture from the air in the stack or room very fast. This means that the water content of the dry product very soon exceeds the limit of the physiological water activity of $\phi = > 0.60$, which is responsible for microbiological deterioration. This causes a wide of range of reactions. Purely biochemical transformations occur more frequently, leading to discoloration, especially of parts of the plant that were previously damaged by pressure, heat or a deficiency of oxygen.

Microbiological deterioration caused by fungal agents can also occur within a short time. Thus at the marginal conditions of the dry product, the most xerophilic species, moulds of the species *Aspergillus* and *Penicillium* form first .

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The metabolism of bacterial and fungal agents releases more and more moisture for more demanding microorganisms such as *Fusarium* and *Rhizopus* so that the attack continues to develop in a kind of cascade effect. The excretions of the microbiological agents also make the stored product smell musty or damp, which are rated very negatively in terms of quality. In addition, there is a risk that stored product will be contaminated with mycotoxins, which are a health hazard. Even the most perfectly dried herb contains 4-6% reactable water in the plant tissues, which can lead over long periods of time, to the formation of undesirable flavour compounds.

Loss of active ingredients is a major problem encountered in stored herbs. These involve various reactions. For example, in the case of essential oil-bearing herbs, during storage, the steam pressure of the oil-water vapour mixture in the drug is lowered considerably in comparison with the essential oil, so that at lower temperatures there is constant evaporation of essential oils, especially if the product is not packed.

Certain components of the essential oils can also undergo transformation as a result of resinification. Similarly, auto-oxidations or enzymatic splitting and rearrangement may occur. These result in loss of active constituents. All these destructive reactions are largely dependent on the storage temperature and duration. They happen much faster at higher temperatures.

The dried product is also a favourite habitat for certain insects. Larvae and beetles generally damage the stored product by eating it up and pollute it with excreta and webs. This reduces considerably the quality and can lead to total deterioration in a short time. The evaporating essential oils and other odour compounds attract the insects intensively over long distances.

The stored product must be inspected regularly to determine its water content, external quality traits, infestation by stock pests and the level of value-determining active ingredients by chemical analyses. These checks including the analyses must be carried out or repeated every four to six months. This way the minimum content requirements for the proposed use of the herb can be complied with.

The characteristics of the storage room also play a major part in maintaining quality and in successful storage. The room should be cleaned and disinfected before products are taken into storage. The room should be airy and cool. The room should have dry room climate and constant curve if temperature. The openings in the buildings should be sealed with wire netting to prevent entry of insects, pests, birds and pets. There should be fire prevention measures. Drugs having different odour should not be stored in the room at the same time. Herbs should not be stored together with toxic drugs. Disinfestation should be carried out only if there is acute occurrence of pests. Larger storage rooms should have mechanical stacking devices.

The packaging should provide necessary protection against the dried products getting more moist again. It should offer protection against infestation by insects. It must minimize evaporation of the essential oils. Finally, it should keep out of light since light can encourage the oxidation of lipophilic constituents.

Crude drugs that have just been taken into storage should be housed initially in a separate room for quarantine until the presence of harmful agents has been cleared. It is important that every individual pack is completely and precisely marked according to its origin with information like name of the herb, origin, details of processing, year of harvest, weight, date of packing and content of active ingredient. The packs should be preferably kept on pallets or shelves. The quality of stored crude drugs can be enhanced by adopting these measures.

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