

ber, or the amount of potassium hydrate absorbed by the ester to form a potassium salt, have all been used with more or less success in detecting adulterations.

Preparation of Volatile Oils.

Volatile oils are generally obtained from plants by the following methods: 1. Distillation with water. 2. Distillation *per se*. 3. Expression. 4. Solution.

1. **Distillation with Water.**—This is the method most frequently employed. The general formula is as follows: Put the substance from which the Oil is to be extracted into a still (see Distillation, page 166), and add enough water to cover it; then distil by a regulated heat into a large refrigeratory. Separate the Distilled Oil from the water which comes over with it.

The substances from which the volatile oils are extracted may be employed in either the recent or the dried state. Certain flowers, however, such as orange flowers and roses, must be used fresh, or preserved with salt or by means of glycerin, as they afford little or no oil after desiccation. Dried substances, before being submitted to distillation, require to be macerated in water till they are thoroughly penetrated by this fluid; and, to facilitate the action of the water, it is necessary that, when of a hard or tough consistence, they should be properly comminuted.

The water which is put with the substance to be distilled into the still, answers the double purpose of preventing the decomposition of the vegetable matter by regulating the temperature, and of facilitating the volatilization of the oil, which, though in most instances it readily rises with the vapor of boiling water, requires, when distilled alone, a considerably higher temperature, and is at the same time liable to be partly decomposed. Some oils, however, will not ascend readily with steam at 100° C. (212° F.), and in the distillation of these it is customary to use water saturated with common salt, which does not boil under 108.4° C. (227.1° F.) (see page 120). Other oils, again, may be volatilized with water at a temperature below the boiling point; and, as heat exercises an injurious influence over the oils, it is desirable that the distillation should be effected at as low a temperature as possible. To prevent injury from heat, it has been recommended to suspend the substance containing the oil in a basket, or to place it upon a perforated shelf, in the upper part of the still, so that it may be penetrated by the steam without being in direct contact with the water. Another mode of effecting the same object is to distil it *in vacuo*. Steam can be very conveniently applied to this purpose by causing it to pass through a coil of tube, of an inch or three-quarters of an inch bore, placed in the bottom of a common still (see page 133). The end at which the steam is admitted enters the still at the upper part, and the other end, at which the steam and condensed water escape, passes out laterally below, being furnished with a stop-cock, by which the pressure of the steam may be regulated, and the water drawn off when necessary. In some instances it is desirable to conduct the steam immediately into the still near the bottom, by which the contents are kept in a state of brisk ebullition (see Fig. 102).

The quantity of water added is not a matter of indifference. An

amount above what is necessary acts injuriously, by holding the oil in solution, when the mixed vapors are condensed; and if the proportion be very large, it is possible that no oil whatever may be obtained separate. On the contrary, if the quantity be too small, the whole of the oil will not be distilled, and there will be danger of the substance in the still adhering to the sides of the vessel and thus becoming burnt. The cage shown on page 168 will be found useful in this connection. Sometimes the quantity of oil is so small that it entirely dissolves in the water, and then the process of *cohobation* is applicable: this consists in repeatedly returning the distillate to a fresh portion of the plant, the water in this way becoming supersaturated, and then the oil can be separated.

2. **Distillation *per se*.**—By this is meant the distillation of certain bodies without the use of water (*per se*, "by itself"). This is done in the cases of certain oleoresins, oils, copaiba, etc., water not being required in the process, and always being difficult to separate from the distillate.

3. **Expression** (see page 246).—This method generally produces the most fragrant products, because there are very few volatile oils whose aroma is not injuriously affected by the action of heat. The volatile oils of the Rutaceæ are mostly made by expressing the rind of the fresh fruit (see page 857).

4. **Solution or Absorption.**—Some volatile oils are so susceptible to decomposition that they are dissociated by distillation, whilst they do not exist in sufficient quantity in the plant to pay for their extraction by expression: in such cases the odorous principle may be extracted by some form of solution or absorption. This may be effected by maceration, digestion, percolation with carbon bisulphide or similar solvent, enfleurage, or the pneumatic process.

Maceration.—In obtaining volatile oils by maceration, the odorous portions of the plant (generally fragrant flowers) are allowed to stand in contact with a bland, inodorous fixed oil, like fine olive oil, oil of ben, or purified cotton-seed oil: the oil absorbs the odor, and after a certain length of time it is strained. The odorous fixed oil is generally used in perfumery.

Digestion.—This process is similar to maceration, except that a moderate heat is employed, by the use of a salt-bath, to aid in the extraction.

Enfleurage is largely used for extracting the odors of very delicate flowers. It is a cold process, and consists in spreading a thin layer of purified inodorous fat upon glass frames (*châssis*): these resemble an ordinary window-sash, with one pane of glass in each. The flowers are sprinkled on the fat, and the frames piled in a stack. The whole is left undisturbed for a time varying from twelve hours to four days. The fat absorbs the odor completely. When strong pomades are desired, fresh flowers are continually added as long as the absorption continues, and the pomades are known commercially as Nos. 6, 12, 18, and 24, the numbers indicating the strength. The volatile products may be obtained from the pomade by chopping the latter into small pieces and macerating them in pure alcohol. A small portion of the fat is apt to be dissolved by this treatment and give a fatty odor to the solution, but this may be separated by subjecting it to cold, when it can be filtered out.