Soluble Tea and Coffee Products

S. B. GADRE*

TEA is as old as civilization itself and it is more universal in appeal than any other single article. Next rival to the popularity of tea is undoubtedly coffee, which in some countries figures more prominently than tea. The manner in which these beverages are consumed varies in a number of ways. An average Indian consumes tea with milk and sugar, while in many European countries it is taken without milk; in some cases, milk is replaced by lemon-juice. Still another strange practice is that followed in Iran, where people prefer drinking three or four cups of plain tea extract at a time, keeping a lump of sugar in mouth. The number of ways in which a cup of coffee can be brewed and served is a legion. In India itself, as one travels from North to South, the coffee cup becomes blacker, stronger and oftener.

One who has had an occasion to prepare a cup of tea or coffee always suited to his exclusive taste, will be able to visualise the inherent difficulties in this operation. Therefore, since the beginning of the present century, a number of attempts were made to simplify the process of making tea or coffee to just dissolving a couple of tablets or teaspoons of syrup in boiling water. The main difficulty in doing this successfully was preservation of the flavour and taste. The earlier products were completely devoid of flavour, and the colour and taste of these resembled anything but the beverages intended. Recent developments in the field of extraction and drying have helped in preparing such soluble and ready-made products to a great extent and at present large scale manufacture of soluble coffee powder is an established food industry. Such coffee products, commercially known as 'soluble,' 'instant' or 'minute' coffee, are vastly improved in flavour and taste, while parallel tea products are not yet successfully produced, probably due to the more volatile and mild nature of tea flavour than that of coffee.

Any process, aiming to prepare soluble products which will be acceptable to the trade and consumer, should produce a product having full flavour of a well brewed beverage and at the same time should not be more expensive than an ordinary cup. Due to the volatile nature of the esters which are responsible for the flavour of tea and coffee, they are completely lost in the subsequent evaporation and drying of the water extracts, unless special care is taken to preserve them. The chemical nature of these substances is very complex and attempts to produce them synthetically have not yet proved successful. The common method employed at the moment is to separate these esters from the extract by distillation and reincorporate them in the final product after which no heat treatment should be given. The products can be prepared either as syrupy liquids or powders in the form of granules or tablets. These, in turn, can be formulated without milk or with milk; in the latter case, the product is really ready-made for use.

The process of producing soluble tea or coffee products, in general, consists in preparing extracts or decoction of the tea leaves or coffee powder in boiling water (raw coffee beans are first roasted and then ground before extraction), removing the volatile esters by distillation, concentrating the weak liquor by vacuum evaporation and final drying

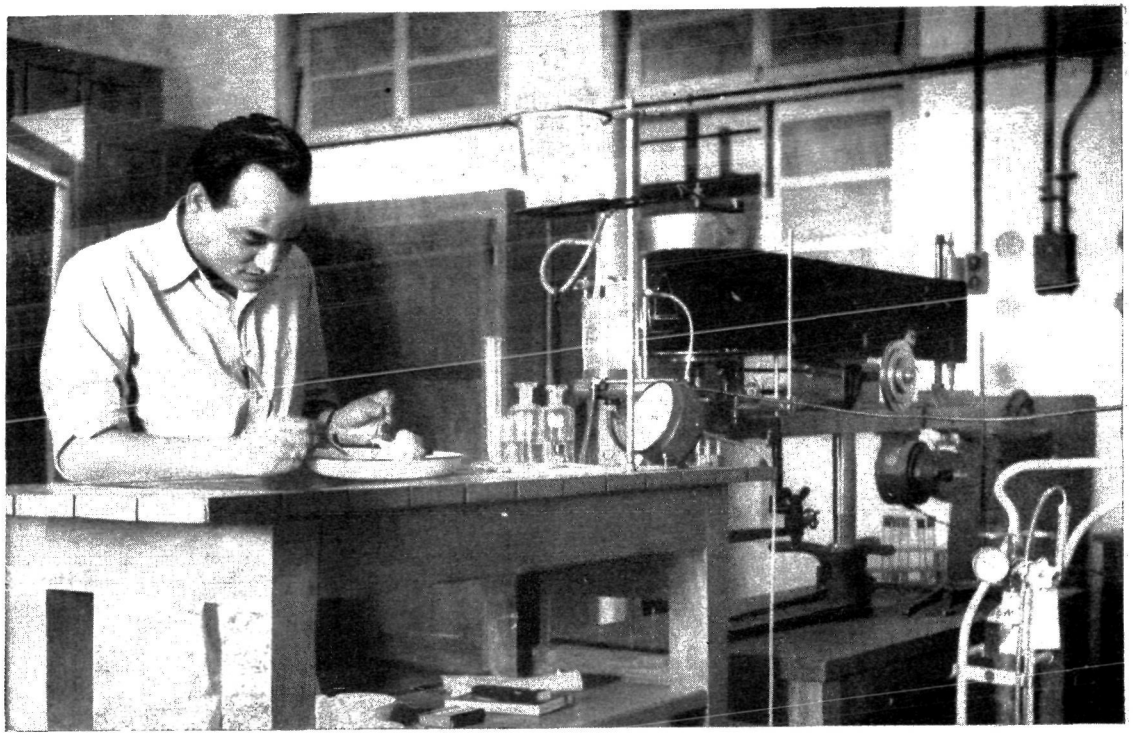
*Demonstrator, Fuels Section.

of the concentrated extracts, preferably in a spray dryer.

(1) *Extraction:* The paramount importance of this step cannot be over-emphasised. This operation must necessarily be carried out in closed vessels to avoid any loss of flavour. This can be done efficiently in two ways. The first consists in stirring the material with water in a steam-jacketed vessel. Although, in this process, the efficient extraction can be carried out even at comparatively low temperatures, it suffers from the disadvantage that a high proportion of the fine particles pass off with the liquor and therefore, subsequent filtration is required to remove them. The other method is basically one of percolation. This method gives clear strong extracts, thus obviating the need of difficult filtration. In this method, the material is kept in a perforated stainless steel vessel and hot water is percolated through the mass. In both these methods, two or three stage counter-current extraction is necessary for efficient results. In the extraction process, the period of infusion and temperature of water is of utmost importance, because if the leaching is carried too far, the extract will be contaminated by bitter substances.

(2) *Recovery of flavour*: The weak liquor, obtained by any one of the above methods, is then concentrated in the evaporator after the volatile esters are recovered by passing the liquor continuously through a still, called 'ester-recovery-system', where the esters are steam-distilled and recovered in the distillate. The manner in which this distillate is further processed depends on the type of soluble products to be made. In case of liquid preparations, the aqueous distillate containing the esters can be used without further processing, while in solid preparations, the general practice is to add the distillate to the strong liquor from the evaporator prior to drying. In case of coffee flavour, there is comparatively little loss in spray drying, the flavour being stronger and less volatile than that of tea. However, in case of tea flavour, according to the results obtained by the author, there is a considerable loss of flavour in spray drying, even if the operation is conducted at low temperatures. This can be avoided by recovering the esters in non-aqueous medium and adding them to the powder or granules after which no heat treatment is given. Volatile solvents like ether etc. can be conveniently used for this purpose, but it is very difficult to remove the last traces of such solvents which ruin the delicate tea flavour. It was found that small amounts of edible oils which have no flavour of their own can be used for extraction of esters, the strong solution containing the flavour being later mixed with powder or granules. If the amount of oil used is kept low, there are absolutely no visible oil drops in the cup prepared from such a product as the milk-solids keep the oil in emulsion form. Moreover, a small amount of oil acts as a fixative for the flavour and also helps as a lubricant in tableting. The flavour of the tea-cup prepared in this way is found to be equal to that of the freshly prepared brew.

(3) *Evaporation*: The liquor, thus freed from the flavour, can then be concentrated in an evaporator working under vacuum. The best type of evaporator is a climbing film evaporator, where the extract is concentrated by circulating through a number of long tubes. The main feature of this evaporator is that the liquor remains in contact with the hot surface for a very short time, which makes it ideal for concentrating liquors containing heat-sensitive substances. In the other types of evaporators (like standard evaporators) where prolonged boiling is necessary for concentration, the product obtained is blacker than the freshly pre-



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pared beverage and also the extract assumes a carbonised flavour.

(4) *Spray-drying*: The spray dryer is a means of converting a solution or slurry directly into powder or granular form by spraying the solution into a stream of heated gas, which evaporates water from the spray. It is unique not only in the short drying time, generally reckoned in seconds, but also in the fact that, owing to the rapid evaporation of water, the solids are not subjected to a high temperature. These characteristics are especially important for heat-sensitive materials like tea and coffee powders, which get deteriorated because of prolonged heating required in other air-drying processes. The other drying process, which is suitable for heat-sensitive materials, is vacuum drum drying, but spray drying has certain advantages over this type also, in giving a fine product of uniform particle size as compared to the flakes obtained by drum drying, which require further grinding. Another distinct advantage of spray drying tea and coffee extracts over other types of drying processes is that the material comes in contact with metal surfaces for a very small period, a factor which often obviates flavour and colour changes.

Important steps in the spray drying process are the atomisation of the fluid, the intimate contact between the hot air and the liquid spray and the recovery of the dried product. Several types of devices such as centrifugal disc or bowl atomiser, a pressure type nozzle or a two-fluid nozzle are used for atomising the liquid. The disc type atomiser is more favoured as it is more flexible in operation, has no tendency to clog and yields a more uniform particle size. The disc is rotated at a very high speed of the order of twenty to thirty thousand revolutions per minute, on which the liquid is fed. The atomiser is located either at the top or bottom of a large cylindrical drying chamber into which is fed hot air or hot products of combustion. The flow of gases with respect to the spray may either be co-current or counter-current or both, and in some dryers the gas stream is given a revolving action either by tangential inlet or by means of tilted vanes. The spray is dried before it reaches the walls of the chamber to avoid a deposit. The dried powder is conveyed by the stream of gas to the separating system. A cyclone separator alone or followed by either a bag filter or a scrubber is used to recover the dried powder. The inlet temperature of hot gases for drying tea or coffee extracts is of the order of 100-180°C, while the outlet temperature is not more than 60-90°C depending upon the rate of feed and humidity of the air. The capacity of the unit can be increased by preheating the feed.

Pure spray dried tea or coffee powders are extremely hygroscopic and tend to "lump" together when exposed to air or when stirred in hot water, rendering the easy solution of the product difficult. The addition of certain carbohydrates such as lactose, greatly minimises these difficulties and it is also found that their presence materially assists in the drying operation.

The spray dried tea powder is brown in colour, completely soluble in water, and is free from any objectionable flavour or taste. The coffee powder is blackish-red with similar properties.

(5) *Formulation, tableting, and preservation*: For preparing liquid tea or coffee products, the concentrated extract is directly used without drying. It is mixed with sugar, saccharin and preservatives such as sodium benzoate, and diluted to required strength using the aqueous solution of flavour recovered in the 'ester-recovery-system'. In case of liquid products with milk, either milk powder or condensed milk can be used.

It is preferable to use skim-milk powder, not containing milk-fat, as the milk-fat masks the real tea or coffee flavour, and also the products without milk-fat show better "shelf-life" as on standing, the milk-fat may separate out, giving rancid flavour. The proportions of the various ingredients are so adjusted that one to two teaspoonfuls should give a cup of tea or coffee to suit the taste of the individual.

In case of solid products, which can be prepared in either powder, granular or tablet form, the spray dried tea or coffee powder is mixed with powdered sugar, saccharin and milk powder (in case of products with milk) and thereafter the oil solution of esters is sprayed over it and mixed thoroughly. The granules can be prepared either by wet method using water or glucose solution as the binder (alcohol being objectionable due to the spoiling of the flavour) or by dry method known as 'slugging,' the latter being preferred due to the sticky and hygroscopic nature of the powders. The granules are dried and flavoured before pressing into tablets. It is advisable to perform these operations in dry and cool atmosphere.

In case of products containing milk, the main difficulties are of preservation and solubility of milk powder. If the packing is carried out in vacuum or in inert gas filled tins, these difficulties are minimised. The packing should be of smaller dimensions, as once the tin is opened it should be consumed as quickly as possible.

In conclusion, it may be stated that if the process described above is followed with all the precautions mentioned to make soluble tea or coffee products, they can serve as good substitutes for tea leaves or coffee powder. It may be argued that the extra cost of processing needed to make these products may prevent their wide-spread use. But it may be noted that the small extra cost of processing is more than compensated for by the advantages offered and also due to the saving in freight effected by reduction in volume. For example, such soluble or ready-made products will have a great potential demand for army engaged in war as they can be carried easily to any place and to prepare the beverages from these products, only hot water is required. For civilian use also, these advantages will be of great importance particularly during travelling or at picnics when an odd cup of tea can be had with the least trouble. For every day use of these products, apart from the handiness, the ease of preparation and the standard good quality of the beverage obtained are added attractions.

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