

# QUALITY AND ECONOMY IN THE PRODUCTION OF TEA

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I propose to discuss with you, in brief, certain aspects of both tea culture and manufacture which have a bearing on the quality and the cheapness of production. I shall also attempt to review some of the developments that have taken place in the factory, during the three years that have elapsed since our last Conference, when Dr Tubbs made clear the point that the lack of sufficient facilities in the factory, especially for withering, had become a serious limiting factor to tea production in Ceylon. The picture has radically altered since then, and the bottleneck most commonly encountered today is the firing operation.

Let us begin by examining certain cultural operations which have a bearing on the quality of the resulting product. It has been known for very many years that the individual properties of the tea bushes play a significant role in regulating the quality of the manufactured product. It is equally well known that conditions which favour slow growth, namely, bright dry weather with cold nights, favour the production of quality teas in the factory. Our Biochemist, Dr R. L. Wickremaninghe, has been working on the theory that quality is low in some bushes, and also, under dull weather conditions, mainly because of the presence of certain inhibitors. His theory is that quality could be regulated at will by curbing the activity of these inhibitors. These ideas have been tested under experimental conditions in the factory and he has been able to introduce high-country quality into low-country leaf, at St Joachim factory in Ratnapura. We still do not know, however, if these ideas could be made to work in a factory equipped with orthodox rollers.

In Dr T. Eden's classical 35-year-old fertilizer experiment (A1) at St Coombs, you may for yourselves the marked difference in the vigour of growth between the various treatment combinations of NPK mixtures. In spite of these differences in the field, tasters were unable to distinguish in quality and valuations between the various treatments. In view of the fact that no differences have been observed even after 35 years of these applications, it can be concluded that the fertilizer applications within the range of this experiment which goes up to 180 lb nitrogen per acre per annum will affect neither quality nor overall valuation.

Samples of clonal tea grown without shade was preferred to the same clones grown under dadap shade with regard to the properties of infusion, strength, quality and valuation. There are indications, however, that the shaded plots gave teas which have more colour than their unshaded counterparts, but this difference is not statistically significant.

Experiments carried out by Mr E. L. Keegel have revealed that quality improves steadily for six months after first tipping and thereafter remains constant right up to the end of the pruning cycle, which, in the case of this experiment, was five years. This finding might add one more reason for extending pruning cycles, for as long as practically possible. Although there is no direct evidence, it is also generally believed that quality improves with the age of the bush.

The effects of poor plucking standards and those of mechanical damage to the leaf in the plucking baskets or during transport to the factory are well known and I do not propose to discuss these matters further.

Lengthening the period of wither produces an improvement in both colour and strength at the expense of quality, as the effects of chemical changes which occur during withering become more pronounced. Optimum results seem to be obtained with a duration of 16 to 20 hours, except perhaps in the flavoury season when shorter periods become preferable; even sourness can result if this process is prolonged for more than 48 hours. The ideal conditions for withering are low temperatures with a hygrometric difference large enough to give a satisfactory wither in this period. The temperature of withering above which quality would seriously be impaired has yet to be determined, but Keegel claims that an artificial wither would produce as good a tea as a natural wither unless the air is excessively heated.

Sixty to 75% of the floor space in any factory is taken up by the withering operation, notwithstanding which, it was the first to feel the need for additional room for expansion as crops began to increase. The first attempt to solve this problem was by replacing existing hessian tats with synthetic open-weave materials such as Kuralon or nylon and this resulted in an immediate doubling of withering capacity on the existing floor space. This change was not as simple as it sounded. Tat posts had often to be reinforced to prevent them buckling in, tat wires had to be tensioned and wrapped, bulking changers had often to be enlarged and new withering fans installed to deliver the additional air required for the increased crops. It now seems that life expectancy of these materials is no more than six to seven years, which also means an expensive replacement programme. Factories today are rapidly being converted from the tat withering system to that of trough withering, some real economies being thereby effected. The trough witherers can cope with approximately four times as much leaf as on hessian and twice as much as on nylon or kuralon, on the same floor space. They require only one third the labour force necessary for tat withering and only half as much fuel. Besides, it has the advantage of requiring very little attention and a negligible cost of maintenance. A panel of four tasters in Colombo were unable to distinguish tat-withered leaf from trough-withered leaf and it can, therefore, be concluded that all the savings in trough operations are being carried out at no expense to quality. The most expensive single item in the trough withering unit is undoubtedly the fan arrangement and further economies have been made in this direction. At the Kakajan tea factory in Assam a single pair of high-speed fans provide air into sixteen troughs working simultaneously. A similar arrangement is being tried out in a factory in the Udapussellawa District, and no doubt, progress made there would be watched with much interest by many.

In East Africa, double-decker troughs are being gradually introduced into a few factories to economize on floor space, but it is unlikely that this system will suit the type of manufacture carried out in Ceylon because the wither required under local conditions is considerably 'harder' than that which is adopted in North India or East Africa.

The degree of wither is yet another factor which reflects itself upon the quality of the ultimate product. With the conventional type of rollers, too soft a wither invariably means a loss of liquoring potential on account of the loss of juice from the rollers, and it also results in a flakey product. On the other hand, if the wither is too hard, rolling will result in the incomplete rupture of the leaf cells and a loss of enzymic activity through dehydration, yielding a poor quality product containing a large percentage of partially fermented, or unfermented polyphenolic substances. This in turn gives rise to the tasters complaint of 'greenish' infusions. However, within the rollable limits of soft wither containing approximately 58% moisture coupled with light rolling is useful for producing well twisted teas and somewhat harder withers containing 53 to 55% moisture in conjunction with hard rolling, is more conducive for the production of good quality high grown, where appearance is not of such paramount importance.

Rotorvanes have certainly made a very big impact in bringing down rolling room costs. A single eight-inch Rotorvane which costs almost the same as a large orthodox roller, has an hourly throughput of around 1500 lb conditioned leaf with a dhool production of up to 60% in a single pass. It can, therefore, be seen that single machine can produce as much dhool as about three of the largest rollers in current production, requiring in the process, about one tenth the combined power of the three large rollers and approximately one third the labour. General experience, both at the TRI, as well as on a large number of estates adopting an orthodox-rotorvane programme, is that it is advisable to pass leaf, given a pre-conditioned roll in an orthodox roller, early into the Rotorvane, rather than carry out one or two orthodox rolls and then pass the bulk through the machine. The purpose of a pre-conditioning roll is at least two-fold. First of all, it imparts a twist which is normally associated with an orthodox black tea and secondly, it facilitates the feeding process. Experimental evidence is also emerging that a pre-conditioning roll is useful for biochemical reasons as well. An orthodox-rotorvane rolling programme has been worked out under conditions prevailing at St Coombs whereby tasters have shown preference for these teas, over teas given four, 30-minute rolls in orthodox rollers, with regard to liquoring properties and also, in overall valuations.

Estates harvesting a poor standard of leaf, however, are experiencing some difficulty with this type of manufacture mainly with regard to dry leaf appearance; overall valuations consequently suffer. One big snag with an orthodox-rotorvane programme is that it ties up a batchwise process to a continuous rolling process thereby cutting down on overall efficiency. The Institute has been fully aware of this short coming and is now negotiating to obtain a continuous pre-conditioning roller for this purpose. Another snag is that licences are not issued for the manufacture of Rotorvanes in Ceylon, and this results in a heavy drain on foreign exchange from the Country. We are therefore, looking into the possibilities of getting the Triturator, which could be manufactured in Ceylon, to work under local conditions. Preliminary experiments have shown that the tea processed through the Triturator are similar to a rotorvanned tea as regards liquoring properties, but that the output of this machine could be as high as 2500 lb withered leaf per hour. Some mechanical modifications are, however, necessary and when these are effected we hope that the machine will be a commercially acceptable proposition, with regard to both initial and operating costs, and also turn out an attractive tea.

Several attempts have been made both in Ceylon and also overseas to mechanize the fermenting operation. The GWA trough fermenting units have found wide application in Africa and one such unit is in the process of being installed at St Joachim for experiments under conditions in Ceylon. Fermenting skips are also in vogue in East Africa, but both these forms of fermenting suffer from the lack of a means of temperature control. A form of drum fermentation is also being carried out in East Africa, but I am unable to comment on its operation. A fermenting machine which achieves better control of both temperature and airflow is also being manufactured locally but it is still premature to say whether this would find general acceptance in Ceylon.

One of the heaviest items of expenditure in the factory is the firing process and a considerable amount of interest is focussed today on cutting down both its capital and operating costs.

The finned heat exchanger, recently put out by one of the firms in Colombo, is a considerable advance on the tubular heat exchangers we have had so far. The use of these units has resulted in a 40 to 50% decrease in drying costs, but its application is limited to liquid or furnace fuel operation.

The TRI has been actively engaged in developing a new type of drier in collaboration with the National Research Development Corporation in Britain. First tests carried out on pilot-scale equipment with dhool samples flown out from the low country have indeed been encouraging. The principle of operation is something hitherto unknown to the tea industry and will be considerably simpler to operate than driers of current manufacture. A proto-type drier of this type will be in St Coombs within the next year and it is hoped that the introduction of these units will remove the bottle-neck that now exists in the factories, and further, reduce manufacturing costs as has already been achieved with the troughs and Rotorvanes in the withering and rolling operations respectively.

Sifting-room equipment has changed very little over the last few years in any country and perhaps the only two pieces of equipment that have made an impact in this operation recently have been the Chota Sifter and the 3T-type stalk extractor. Perhaps the most exciting line in this department that is now being pursued by the TRI, trading interests, as well as by the Minister of Commerce is in examining the possibilities of substituting paper bags for the conventional plywood chests. The problem of effective sampling and subsequent re-sealing of these bags is one of the difficulties now encountered, but these problems do not seem insurmountable. It is estimated that their use will reduce the cost of packing materials to approximately one third or one fourth of that which the estates now have to meet, and also reduce the foreign exchange drain from the Country by about 15 million rupees annually based on the 1964 level of imports.

These improvements in the manufacturing operations within the factory have considerably altered the design and reduced cost of putting up new factories. Pelawatte, Sinharaja (Enselwatte), Willie Group, Laxapana and Mocha factories are very considerably different in design from the existing factories and each of these have profited from the experience gained from the others. For instance, the troughs at Pelawatte are coupled to individual heat exchangers making the installation relatively expensive. Costs have been trimmed further at Willie Group. Sinharaja represents an advance on factories that preceded it, in that it was probably the first single floor tea factory built in Ceylon with an arrangement to duct hot air from the firing room in order to save on installation costs. All these factories cost only a fraction of what they would have cost had they been built as tat-withering factories and I can see further reductions in building, equipment and operation costs in the future as factories begin to have trough witherers coupled to rotorvane or triturator type of rolling with the new type of drier which I hope will prove to be as good as it now sounds.