ABSTRACT

Tea is the most popular beverage in the world. Currently, India is the second largest producer and major consumer of black tea in the world. In recent years, the Indian tea industry is in crisis due to extensive competition in the international market. To overcome the global competition, there was a need to reduce the production cost of tea in India, with major emphasis on black tea made with CTC machines, which accounts for around 90% of total tea production in India. An alternative method of maceration was attempted. This machine uses blades rotating at high speeds to macerate the tea leaves. The size of macerated tea leaf particles was almost identical to that produced in the conventional macerating machine in India.

The physical properties of tea leaf were measured. The bulk density and angle of repose of withered tea leaves at 70% moisture content (wb) were found to be 95.70 kg/m^3 and 76° respectively. Weight contributed by bud, first leaf, second leaf and stem was found to be 8.84, 23.57, 41.85 and 25.75% respectively.

The tea leaf was withered, precut and metered before feeding to the macerator. Macerator discharged the leaf particles at the bottom and this was collected in a tray. The macerated particles were fed to a granulator. Mean size of granules produced at 300, 400, 500 and 600 rev/min impeller speed was 1.48, 1.21, 0.95 and 0.90 mm respectively. Size of the granules can be controlled by changing the impeller speed. A laboratory model tray drier was fabricated for drying tea. It was installed with 2 kW electrical heater and was used to dry 100 g sample of fermented tea granules at 120 °C temperature. Drying time required was 22 to 25 min. The quality of dried tea was also determined.

A laboratory model macerator was developed with three rotors each carrying a set of blades. It was tested in laboratory conditions. Number of blade and blade helix angle of the first two rotors were decided initially through trials. Number of blade and the blade helix angle of the third rotor were varied. Rotor tip speed was varied from 30 to 83 m/s and feed rate from 30 to 80 kg/h. Size of the leaf particles was from 0.183 to 3.72 mm and energy requirement for operation was from 0.0239 to 0.1676 kWh/k*g* of withered leaf. It was found that number of blades, blade helix angle, rotor tip speed and feed rate had significant effect on the size of macerated particles and energy requirement. These variables were used to formulate regression equation for the required torque and size of particles using Design-Expert software. It is recommended that the number of

blade would be 8 and blade helix angle would be 60°. The feed rate would be 80 kg/h and rotor tip speed can be chosen between 45.26 and 58.40 m/s depending on the size of particles required. It was known that particle of size 0.59 mm and smaller would be used producing the tea. Effect of number of blade less than eight is not known because minimum number of blade tried was eight.

The tea produced using the leaf macerated by the prototype had Theaflavin (TF) content 1.29%, Thearubigin (TR) content 12.25%, TR/TF ratio 9.51, Total Liquor Colour 4.09 and Brightness 28.09%. This is comparable to that of the black tea available in the Indian market.

The prototype macerator requires marginally less amount of energy compared to the current machines when particles of same size are produced. Also it is capable of producing smaller size particles. Life of working elements in the prototype is much larger than in the current machines, thus reducing the maintenance cost. The prototype macerator can be used for producing tea in small quantities compared to the current machines which produce 800–1200 kg/h. This will be beneficial to the small farmers who cultivate about five hectares of land and build a micro size factory. It occupies less floor area compared to the machines available in the market.

Keywords: Black tea production, Maceration, Granulation, Withering, Fermentation, Drying