SUBJECT: PLANTATION CROPS , B.Sc. (Hort) second year II sem
Topic no. 26.
Tea: Harvesting/pluking, Processing and yield

Submitted by
Rashmi Pandey

4/3/2023

RASHMI PANDEY
Terminologies in tea plucking

- **Plucking Table:** Even flat well trained surface of tea bush formed after tipping laterals coming from primaries from which harvesting or plucking is done.
- **Plucking standard:** Average size of the shoots harvested.
- **Plucking interval or Plucking round:** Interval between 2 successive plucking in one area.
- **Rush period:** Active growing or high cropping period.
- **Lean period:** Low cropping period.
- **Janam:** Two scale leaves that covers the axillary bud present in the leaf axils.
- **Banji:** Apical dormant bud, a smaller, little swelled bud that requires 4-6 weeks to develop into leaf.
- **Fish leaf:** After unfolding of janam, a small, underrated, oval shaped leaf without any definite apex emerges out, called ‘fish leaf’. (is unsuitable for manufacturing).
• **Janam plucking:** Proved superior in North East India under Imperial soil environmental condition

• **Fine plucking or:** (2 leaves + bud) Plucking just above the mother leaf plucking: mother leaf (the first normal leaf)

• **Medium plucking:** 3 leaves + bud or Fish leaf plucking: Plucking at the point just above the fish leaf.

• **Coarse plucking:** more than 3 leaves + bud

• **Black plucking:** A type of plucking, wherein all projections above plucking table, except janam and/or unopened buds are plucked
• Smaller the leaf, the more expensive the tea
## Different standards of tea plucking

<table>
<thead>
<tr>
<th>S.N</th>
<th>Category of plucking</th>
<th>Type of shoot detached</th>
<th>Plucking round (days)</th>
<th>Net crop gain or loss over standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Fine</td>
<td>All 1+B, all 2+B &amp; single banjhi</td>
<td>5-6</td>
<td>-11.3%</td>
</tr>
<tr>
<td>2.</td>
<td>Standard</td>
<td>Large 1+B, all 2+B &amp; single banjhi</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>Medium</td>
<td>All 2+B, all single &amp; double banjhi</td>
<td>7-8</td>
<td>+0.5%</td>
</tr>
<tr>
<td>4.</td>
<td>Course</td>
<td>All 2+B, 3+B &amp; all banjhi</td>
<td>8-9</td>
<td>+26.2%</td>
</tr>
<tr>
<td>5.</td>
<td>Very course</td>
<td>All 3+B, all banjhi</td>
<td>8-10</td>
<td>+38.4%</td>
</tr>
</tbody>
</table>

(Single banjhi= one leaf + banjhi bud, Double banjhi= two leaves + banjhi bud)
Packing of plucked leaves for processing
Tea processing

1. harvesting
2. withering
3. rolling
4. roll breaking
5. fermenting
6. drying
7. grading
8. packing
Tea processing

- **Fresh tea leaves**
- **Withering**: Allow water to evaporate from the leaves.
- **Bruising**: Damage leaf edges to encourage oxidation.
- **Oxidation**: Oxidize the leaves to develop flavors.
- **Fixing**: Pan fire the leaves to stop the oxidation process.
- **Rolling**: Shape leaves according to tea style.
- **Drying**: Further dry the leaves for shelf stability.
The Process of Pu-erh Raw Tea and Ripe Tea

- Rolling
- Pan Frying (Inactivation of Enzymes)
- Drying under the sun
- Compression
- Fermentation by Mold
- Aging by Storage
- Compression
- Vintage Pu-erh Raw Tea

Loose Pu-erh Raw Tea
Loose Ripe Tea
Pu-erh Ripe Tea
1. Withering:
- Removal of surface moisture from leaves
- Increases organic acids and PPO activity

<table>
<thead>
<tr>
<th>CTC</th>
<th>Orthodox</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf moisture content</td>
<td>70-75%</td>
</tr>
<tr>
<td></td>
<td>50-55%</td>
</tr>
<tr>
<td>Duration</td>
<td>10-15 h</td>
</tr>
<tr>
<td></td>
<td>18-24 h</td>
</tr>
</tbody>
</table>

- Tea manufacture involves disruption of the cellular integrity of tea leaves, thereby enabling the mixing up of substrates (polyphenols) and the enzymes (polyphenol oxidases).
- Initiates with the uptake of atmospheric oxygen and formation of oxidized polyphenolic compounds along with volatile flavor compounds that impart characteristic aroma to tea.
Judging the end point of withering

- **No cracking sound:** Well withered leaves will not produce any cracking sound when squeezed i.e., it must not be too dry.
- **Compact ball:** Withered leaves when pressed by hand should form compact ball.
- **No brittle stalk:** The stalk of the withered leaves should not be brittle.
- **Feel test:** Withered leaves will have silk hand feel to touch.
2. **Rolling:**

- During rolling cells of leaves are broken to liberate sap containing polyphenol oxidase.
- Rolling takes place for about 30 to 40 minutes.
Maceration or Rolling CTC:

- Withered leaves rolled through CTC machines
- Polyphenol and enzymes exposed to atmosphere
- Well rolled leaf taken for fermentation.

Orthodox method

- Rolling of leaves in rollers as if it is rolled between palms of hands, for 45 min.
- Twisting and maceration, well rolled leaf removed (roll breaking)
- Well rolled leaf taken for fermentation.
3. Fermentation:
- Spreading leaf & Carried out at low temp. (20°C) and high 95%RH, 2-3 h (orthodox method)
- In a Revolving drum (25°C-27°C) for 60-90 min (CTC) with conditioned air
- Pleasant aroma & Leaf color green to coppery- completion of fermentation
- Optimum ratio of TF to TR is 1:10-1:12

**Polyphenol Oxidase**

- **Catechins**
  - **orthoquinones**
  - **Theaflavins**
  - **Thearubigins**

**Theaflavins** - 0.3-2% of dry wt. - astringency, briskness, color

**Thearubiginins** - 9-19% of dry wt. - strength, mouth feel color
**Duration of fermentation:** Generally, in south India, fermentation is done for 60-90 minutes.

**Time of fermentation:** It varies from one to three hours (1 to 3 hours)

- 2 hours: Maximum briskness and quality is obtained except strength.
- 3 hours: Good strength and colour but poor briskness and quality.

During this process the colour of the leaf changes from green to a bright coppery red. Fermentation is carried out under conditions of high humidity and low temperature (24 – 26.6°C). The end products of fermentation are the **aflavins** and the **arubigins** which are responsible for the briskness, brightness and colour of tea liquor.

**High temperature fermentation:** Too high a temperature results in over – fermentation and inferior product, further changes are arrested by drying in special dryers.
Drying or Firing

- Objective of drying is to arrest fermentation.
- Slow reduction in moisture content as to stop fermentation process.
- Moisture content is reduced to about 4%.
- Duration is for about 30 - 40 minutes.
4. Drying

➢ To terminate biochemical reactions
➢ To reduce moisture content (2.5-3.0%)
➢ To improve black tea character and flavour

• fermented leaf is subjected to a blast of hot air
• The optimal inlet temperature for CTC processed leaf is $100 \pm 5^\circ C$.
• Exhaust temperature $54.4 \pm 2.7^\circ C$.
• Drying below 1.0% - loss in quality.
• Above 3.0% moisture content - loss of keeping quality.
• Black color due to transformation of chlorophyll to pheophytin
• Polyphenols combine with tea leaf proteins - reduction in astringency
Sorting and Grading

Remove stalks fibers and grade the tea by passing through different sized meshes.
## 5. Grading

<table>
<thead>
<tr>
<th>Whole leaf grade</th>
<th>Broken Orange Pekoe, Orange Pekoe, Pekoe, Souchong, BOP fannings, Fannings, Dust</th>
</tr>
</thead>
<tbody>
<tr>
<td>leafy grade</td>
<td>Flowery pekoe, Pekoe</td>
</tr>
<tr>
<td>Broken grade</td>
<td>Primary dust (BOP dust, Fine dust) and Secondary dust (Pekoe dust, Golden dust, Superfine dust)</td>
</tr>
</tbody>
</table>
Quality Control

Use same weight of tea per cup
Allowed to steep in hot water same time
Grade indicated by cup placement
Labeling & packaging
Machinery used in tea processing

1. Air Dry
2. Circling to Dry
3. Roasting
4. Shaping
5. Balling
6. Tos to Tea Dust
7. Loosing & Sifting
8. Spicing
9. Separately Packing
10. Air Container
11. Packing & Sealing
Types of tea based on processing levels

- White tea
- Green tea
- Light oolong tea
- Black oolong tea
- Black tea
- Pu-erh tea
Leaves & Buds

Steamed
- Pan fried/Steamed
  - Rolled/Shaped
    - Dried
      - White Tea

Withered
- Bruised
  - Oxidized (brief)
    - Pan fired/Dried
      - Oolong Tea
  - Bruised/Rolled
    - Oxidized (full)
      - Fired/Dried
        - Black Tea
White Tea

- Leaf buds fully open and are still covered with fine silky hairs.
- Quickly air dried
- White tea is said to have three time more antioxidants than green or black tea.

Green Tea

- Without fermentation.
- China and Japan
- Polyphenols, Catechins,
  - and Flavonoids
Oolong Tea

- between green tea and black tea.
- Non fermented tea
- “green” and “amber” style.

- The “amber” styles are allowed to oxidize slightly more than the “green style” oolong tea.

Black Tea

- Global output 73%
- Fermented
- Theaflavin and Thearubigins
Processing of white tea

Harvesting of tea leaves → Withering of tea leaves → Steaming → Drying of tea leaves → White tea leaves

Processing of Green tea

Harvesting of tea leaves → Withering of tea leaves → Steaming → Drying of tea leaves → Partial oxidation of tea leaves → Rolling and shaping → Green tea
Processing of Oolong tea

- Plucking
- Outdoor withering
- Indoor withering
- Pan-firing
- Rolling
- Drying

Images of Oolong tea processing steps and samples.
1. Orthodox process
   - Withered leaves are rolled on specially designed orthodox rollers which twist and crush the leaves thereby rupturing the cells.
   - Maceration is less against CTC processing.
   - Tea with good flavor and aroma.

2. CTC (Crush, Tear and Curl)
   - Withering
   - Leaf maceration or rolling
   - Fermentation
   - Drying
   - Grading
**Instant Tea**

- Water soluble extract of black tea is **spray dried** to powder form
- Tea solids extracted with hot water, concentrated and freeze dried

**Caffeine free tea**

- Decaffeinated by organic solvents

**Herbal tea**

- Green tea mixed with medicinal plants and flavoured with cardamom, mint

**RTD Teas:**

- No complete tea characteristics, just to serve the thrust of casual drinkers
- 5-10% of soluble tea solids.
Picking and Withering

Premium loose leaf tea must be picked by hand, often by women wearing baskets balanced on their heads or shoulders. During withering, warm air is blown over the picked tea leaves to reduce moisture and make the leaves pliable for the processes to follow.
Yield of tea

Average Yield of harvested fresh leaves -1500 -1700 kg/hectare
100 kg fresh leaves gives 25kg finished tea
### Biochemical compounds responsible for taste in tea

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Taste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyphenol</td>
<td>Astringent</td>
</tr>
<tr>
<td>Amino acids</td>
<td>Brothy</td>
</tr>
<tr>
<td>Caffeine</td>
<td>Bitter</td>
</tr>
<tr>
<td>Theaflavins</td>
<td>Astringent</td>
</tr>
<tr>
<td>Thearubigin</td>
<td>Ashy and slight astringent</td>
</tr>
</tbody>
</table>

### Biochemical compounds responsible for colour

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theaflavins</td>
<td>Yellowish brown</td>
</tr>
<tr>
<td>Thearubigins</td>
<td>Reddish brown</td>
</tr>
<tr>
<td>Flavonol glycosides</td>
<td>Light yellow</td>
</tr>
<tr>
<td>Pheophorbide</td>
<td>Brownish</td>
</tr>
<tr>
<td>Pheophytin</td>
<td>Blackish</td>
</tr>
<tr>
<td>Carotene</td>
<td>Yellow</td>
</tr>
</tbody>
</table>
Biochemical compounds responsible for flavour

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Flavour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linalool, Linalool oxide</td>
<td>Sweet</td>
</tr>
<tr>
<td>Geraniol, Phenyl acetaldehyde</td>
<td>Floral</td>
</tr>
<tr>
<td>Nerolidol, Benzaldehyde, Methyl salicylate, Phenyl ethanol</td>
<td>Fruity</td>
</tr>
<tr>
<td>Trans-2 Hexanal, n-Hexanal, Cis 3-Hexanol, Grassy, b-Ionone</td>
<td>Fresh flavour</td>
</tr>
</tbody>
</table>
Tea Processing: Effects on Polyphenols & Staining

Catechins & Total Polyphenols

- **White Tea** (mature leaves)
  - Steamed (oxidase inactivation) → Dried
- **Green Tea** (mature leaves)
  - Withered → Steamed or Panfired (oxidase inactivation) → Dried
- **Yellow Tea** (mature leaves)
  - Withered → Steamed or Panfired (oxidase inactivation) → Dried → 2nd Oxidation
- **Oolong Tea** (mature leaves)
  - Withered → Bruised → Partially Fermented → Panfired → Dried
- **Black Tea** (mature leaves)
  - Withered → Rolled → Fully Fermented → Fired → Dried
- **Pu-Erh Tea** (aged leaves)
  - Withered → Rolled → Fully Fermented → Fired → Dried → Piled (aged)

Theaflavins & Thearubigins

Theabrownin
thanks