



# Training Manual



## COCOA TO CHOCOLATE



**S. Elain Apshara  
N. Venkatesh Hubballi**



**Central Plantation Crops Research Institute  
(Indian Council of Agricultural Research)  
Regional Station, Vittal, Karnataka- 574 243**



Training manual

## **COCOA TO CHOCOLATE**

Text prepared and edited by

**Dr. S. Elain Apshara**

Senior Scientist (Horticulture)

**Dr. Venkatesh N. Hubballi**

Director, DCCD

March 2013

Published by

CPCRI, Regional Station, Vittal, Karnataka.

Sponsored by

Directorate of Cashewnut and Cocoa Development (DCCD)

Cochin, Kerala.

## COCOA TO CHOCOLATE

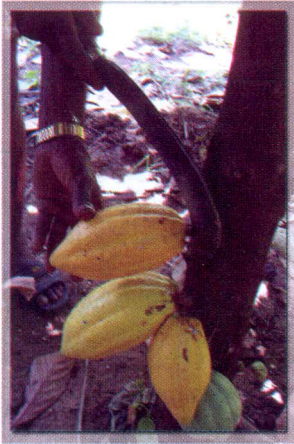
Cocoa (*Theobroma cacao* L.) called as Food of Gods is the source of chocolates and became the food of common man with its tasty, nutritious and valuable products. In India, cocoa is being grown as a mixed crop in arecanut and coconut gardens giving an additional remuneration to the farmers. The demand for cocoa-based products has been growing at a rapid rate of 15-20 per cent per annum. Though the current price for farm produce is adequate there is so much difference between raw cocoa and finished product. Chocolate as such in commercial scale is manufactured in large factories and small chocolate units are using cocoa bars or chocolate blocks of these factories and modifying into value added products by adding nuts, raisins, dry fruits and other edible materials. To overcome the risks on non procurement by companies and marketing failures, knowledge on systematic processing of cocoa is important which ultimately decide the quality of the final product. Training on farm level primary processing and chocolate making is necessary which will help cocoa planters as well as women beneficiaries.

### Pre and Post Harvest Technology

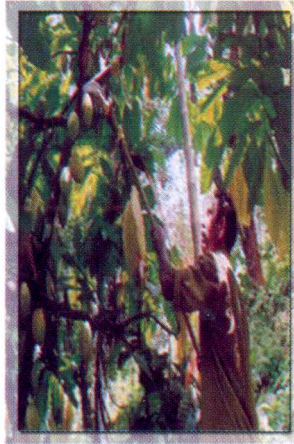
Depend upon the agro climatic conditions cocoa bears fruits, the pods, over several months of the year. At Karnataka and Kerala the main harvest season is during May - July and a second crop is observed during October - November. Grafted plants showed early and extended harvests. In Tamil Nadu the peak is observed in November and in Andhra Pradesh during April- June. The pods mature in about 150 to 170 days from the day of pollination and in Western Ghats region the days for maturity observed is from 135 -160. When the colour of husk changes either from green to yellow or red to orange, the pods are harvested. The pods may remain on the tree without damage up to a maximum of about one month and they may be harvested at an interval of 2-3 weeks. If mammalian pests like rats and squirrels are more then the harvest may be preponed. Harvesting with sharp knife or cocoa harvester is advised. During harvest, cut is given at the fruit stalk without damaging the cushion or the flowering stem. The pods are heaped in shade for 2-3 days which enhances fermentation inside the pod itself. If the pod is shaken with hand it will give a sound, which makes sure the detachment of beans from the husk. After three days pods are broken by banging on hard surface or with wooden hammer. Beans from the split pods are scooped out by hand and parts of placenta, germinated, underdeveloped and rotten beans are removed. On an average, 8-10 pods will give one kg of wet beans and three kg of wet beans from 25-30 pods will give one kg of dry beans.



Ripe pods ready for harvest



Harvesting with knife



Knife tied on pole



Cocoa harvester



Heap of pods - pre fermentation



Breaking pods

## I. Primary Processing

### 1. Fermentation

Fermentation is the foremost part of cocoa processing which helps in imparting flavour and taste to the product. The fresh beans or the wet beans are covered with sugary white mucilage or pulp which undergoes biochemical changes and disappearing as sweatings during fermentation. The object of fermentation is not to remove this pulp, but to help develop typical chocolate characteristics. The raw beans are bitter and astringent which gains chocolate aroma after fermentation and drying. Fermenting mass is generally covered to conserve the heat, at the same time air is allowed to pass and this process takes a minimum of four to six days. There are different methods of fermentation which are described below.

#### A. Traditional methods

Various methods are adopted for fermentation in different cocoa producing countries. Among them, Heap, Box and Tray methods are considered as the standard methods.

### 1. Heap method

Heaping a minimum of 50 kg wet beans over a layer of banana leaves on a sloppy floor or raised platform and covering with folded banana leaves to conserve heat is followed in this method. On the second day the heap is covered with gunny sacking. On the third and fifth days the heap is dismantled, beans are mixed and again kept in position. It needs about six days for the completion of fermentation and the beans are taken out for drying on the seventh day. Quantity of heap may be increased to get effective fermentation.

### 2. Tray method

Wooden trays of size 90 cm x 60 cm x 13 cm with reapers fixed at the bottom with gaps in between are used and filled with 45 kg beans at 4" deep in trays which are stacked one upon the other in tiers of 6 to 12 in this method. After loading with beans the top most tray is covered with banana leaves and after 24 hours it is covered with gunny sacking to conserve the heat that develops. An empty tray is kept at the bottom for drainage of sweatings. On the fifth day the beans are taken out for drying. Trays are convenient to handle, there is no requirement for mixing and duration of fermentation is reduced from six to four days. Individual trays arranged horizontally are also used by farmers.

### 3. Box method

To process large quantities of beans, box method is followed in estates and big plantations. Series of wooden boxes of 1.2 m x 0.95 m x 0.75 m size which will hold 1 ton of wet beans are being used. Holes are provided both at the bottom and sides of the boxes to allow the flow of sweatings and to facilitate aeration. The beans are mixed every alternate day by moving them from one box to the next and a minimum of three boxes are involved in this turning process. They are arranged in a row and transferring beans is done by lifting them. To make it convenient, the box are sometimes arranged in tiers and shutters are provided on one side of the box so that the beans falling from the box at the top will run to the lower box on removing the shutters. The beans are mixed on alternate days, on the third and fifth days and are taken out for drying on the seventh day.

## B. Small scale methods

Three methods are being used in India for on farm and small scale processing of beans in lesser quantities, they are mini-tray, mini-basket, mini-box, gunny bag and heap methods.

### 1. Mini-tray method

Using wooden trays of 60 cm length, 25 cm width and 10 cm deep with split cane bottoms are considered as the best method. It is divided into a number of sections by means of wooden partition that will fit into appropriate grooves at required distances and it can be adjusted depending upon the quantity of beans available. 10 kg beans are filled in these trays, levelled and fermented. For research purpose plastic trays with drain holes are used for lesser quantity beans.

### 2. Mini-basket method

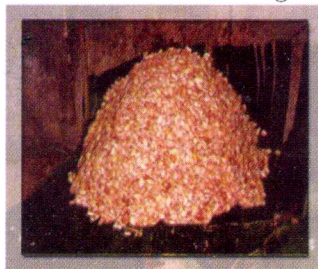
Bamboo baskets of 20 cm diameter and 15 cm height to hold 2 kg beans are used in this method. For larger lots of upto 6 kg, height of the baskets may be increased to 40 cm. These baskets are lined with banana leaves, wet beans are filled, compacted, covered with banana leaves and placed on a raised platform to allow flow of drippings. After 24 hours, it is covered with gunny sacking. The beans are taken out and stirred well after every 48 hours and allow for drying on the seventh day.

### 3. Mini-box method

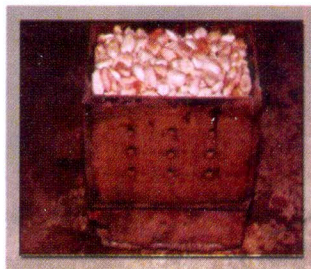
Small boxes are used for processing a minimum quantity of 2 kg wet beans. These boxes are with 1 cm diameter drain holes at bottom and sides, covered with banana leaves, kept in raised platform and fermented in the way same as mini basket method.

#### 4. Gunny bag method

Clean gunny bags and polythene lined bags also used for fermentation. Beans are filled loosely in the bags, tied and allowed to drain sweatings for one day. The gunny bags are heaped one over the other and insulated properly to conserve heat. The beans are shaken and mixed thoroughly without opening the bag on third and fifth days. The beans are taken out for drying on the seventh day. CAMPCO is currently practicing this gunny bag method widely to ferment the collected beans along with other traditional methods.



Heaping small quantity



Mini box



Mini basket



Banana covering



Mini tray



Gunny bag fermentation

#### Factors affecting fermentation

Only healthy ripe pods are to be harvested for fermentation. Over ripe pods will have germinated beans which may pave way for moulds and insects and it should be avoided. Unripe pods will have low sugar content which affects the fermentation process and ultimately the quality. Quantity of beans also decides the quality of cocoa. The heat generated during fermentation is retained by insulation which is good when used around 100 kg beans. The duration of fermentation depends on the type of cocoa and season. Criollo type cocoa with white beans, requires only two or three days, whereas Forastero and Trinitario cocoa types, with purple beans, requires six days. Turning the beans during fermentation ensures uniform fermentation. Change in weather influence the temperature and humidity and the processing environment. Dry season is better than wet season because of less incidence of moulds, but high fat content observed with monsoon beans.

Well fermented beans are plumpy and are filled with a reddish brown liquid. The testa becomes loose and detached from the cotyledons. When cut open the cotyledons will have bleached appearance in the centre with a brownish ring at the periphery. Fermented beans will have 55% moisture and it has to be reduced to 6% by immediate drying.

## **2. Drying**

The fermented beans are dried either in the sun or by artificial means with mechanical driers. Sun drying is done in thin layers of 2-3 cm depth and with time to time stirring. Under normal sunny weather drying is completed in 7 to 10 days. While drying in mechanical driers, care must be taken to avoid exposure of beans to smoke and fumes and temperature should not exceed 60°C. The temperature, rate of airflow, bean depth and frequency of bean stirring decide the extent of drying and ensure the quality. Solar driers are significantly more efficient. If a fistful of beans is compressed in palm they produce a characteristic cracking sound with proper drying.

## **3. Storage**

Under the conditions prevailing in the cocoa growing belt of India the humidity is too high that the beans absorb moisture which is not safe for long term storage. Dried beans are packed in polythene lined gunny bags and stored upto 2 months. Beans are cleaned off of flat and broken beans before storage. The store is sufficiently ventilated and the bags are kept on a wooden platform set over the floor with 15-20 cm space. Cocoa can absorb any odour and retain it permanently and so cocoa is stored away from spicy and smelly food stuffs. Smoky or fume surroundings also bad for cocoa storage.

## **II. Secondary Processing**

The different stages are,

### **1. Alkalization :**

It is practiced to reduce the bean acidity, increase the dispensability of powder and to add deep colour to the powder. The dried beans are alkalized in a solution of 1% Sodium bicarbonate (10g in 1 litre of water for 1 kg beans) for 3 hours. The beans are then dried in sun for 1-2 days.

### **2. Roasting :**

The alkalized and dried beans are then roasted in kitchen pans or roasters depending upon the quantity, for about 20-30 minutes. The end point of roasting can be judged by the cracking sound of the beans and the development of characteristic chocolate smell. After roasting, the beans are spread out.

### **3. Kibbling :**

The term indicates the separation of the testa/ outer cover or the shell from the roasted beans. It can be done manually with the help of a small knife.

### **4. Grinding:**

The nibs, seeds without testa are then ground into paste in a wet grinder or colloid mill till a fine consistency is achieved. The product obtained is called 'cocoa mass'. The mass is semi solid due to the high content of fat (57%) in the beans.

### **5. Separation of cocoa powder and butter :**

To make different cocoa based products cocoa butter is to be separated from the cocoa mass. The separation is done using a cocoa butter extractor. Kerala Agricultural University fabricated a butter extractor which works on the principle of a hydraulic press. The cocoa mass is poured into a cloth bag, tied at the top and placed at the base of the cylinder. When pressure is applied the butter oozes out through the holes and gets collected in the vessel at the bottom. The powder obtained from the cloth bag is called cocoa cake. This cake can be powdered and sieved to get cocoa powder.

