HARVEST & POST-HARVEST PRACTICES

Harvest • Fermentation • Drying • Micro-fermentation

Information for this chapter is taken from CAOBISCO/ECA/FCC Cocoa Beans: Chocolate and Cocoa Industry Quality Requirements. September 2015 (End, M.J. and Dand, R., Editors), primarily chapters developed by members of the Technical Committee or to which they have contributed. We highly recommend that you seek guidance in this guide, which provides an extensive overview of post-harvest procedures, internationally accepted cocoa quality standards, and quality testing methods. The guide can be downloaded on www.cocoaquality.eu

HARVESTING

- Keep tools and equipment clean and well-maintained.
- Harvest pods as soon as they ripen: generally, harvest every week during peak periods and every two weeks in non-peak periods.
- Carry out a separate weekly sanitation check and remove diseased, insect damaged and mummified pods using tools that are only used for this purpose.
- Avoid damaging the flower cushions and other parts of the tree when cutting the pods.
- Avoid unnecessary cutting or wounding of the pods: do not use a machete to pick up pods from the ground.
- Do not store wounded or damaged pods for longer than one day before they are opened and fermented.
- Undamaged pods should normally be opened within a week of harvest.
- Keep tools and equipment for opening pods clean and well-maintained.
- Break open the pods without causing any damage to the beans.
- Discard any beans which are mouldy, diseased, discoloured, damaged or germinated.
- Keep good quality beans free from contamination as they are moved to the fermentation area.
FERMENTATION

Ensure the fermentation method is appropriate to the bean type, climate, quantity of beans and locally available technology. The fermentation process used should be according to the best available technologies that bring out the intrinsic qualities of the genetics and “terroir” and follow these guidelines:

- Only seeds from healthy pods should be used for fermentation
- Removal of the placentas, empty and diseased beans should be done after pod breaking
- Fermentation in large enough amount (minimum amount of wet beans of 100 kg = 1,000 pods) to allow for adequate fermentation conditions
- Heap, basket or box fermentation, or other traditional process
- Fermentation mass to be covered and protected from rain and/or cold
- Duration of fermentation will depend on the variety and local conditions (between 2-7 days)
- Turning of the fermentation mass in an appropriate way, depending on cocoa variety. If unknown use 24, 48 and 96 hours after initiation of fermentation
- Only experimental samples may be produced through a “micro-fermentation” method (in mesh bags placed inside large cocoa fermentation masses).

DRYING

The final moisture content of the samples should be less than 8% and follow these guidelines:

- Sun-drying recommended (when possible)
- Protection from rain is required during the drying process
- Covering of beans required during the night
- Thickness of layer of drying between 3 and 5 cm to avoid mouldiness or over-fermentation
- Optimum drying is to 6.5-7.8% humidity (with duration of 5 to 10 days, generally)
- Drying is complete when beans are crispy and have lost elasticity when pressed in the hand.
MICRO-FERMENTATION

Guidance on post-harvesting processing techniques suitable for use where limited quantities of beans are available, developed by D. Sukha and E. Seguine

Typically, fermentations require in the order of 50kg of wet beans, but the following guidelines can be used to prepare samples for flavour evaluation where more limited quantities of beans are available.

Harvesting, pod-breaking and bean extraction for small-scale fermentations

The guidelines provided above should be followed to ensure that only fully mature, ripe but not over ripe, non-diseased pods are harvested. Where the Batch insert micro fermentation method is to be used to ferment a sample of beans enclosed within a mesh bag within a larger fermentation mass, it is important to ensure that the pods to provide beans for the surrounding fermentation mass are harvested on the same day as the sample pods.

Fermentation

Fermentations of samples for flavour testing can be achieved in different ways but regardless of method used, should be carried out in a covered and sheltered space providing adequate protection against rain, wind and direct sunlight and should start immediately or within six hours after the beans have been extracted. The timing of turning(s) or mixing of the fermentation mass, and the optimal endpoint of the fermentation will vary according to the variety. For most “Forastero” and Trinitario types the first turning will be at 48 hours, with a second turning at 96 hours, and the optimal end point is likely to be between 120 – 168 hours. Fermentation times for Criollo varieties could be as short as 48 hours with no turning or one turning after 24 hours. Regardless of variety, optimal end point can be assessed visually by cutting a few beans and looking for well-defined internal ridging.

Batch insert micro fermentations

This technique can be used to ferment samples of beans contained within a mesh bag (also referred to as a “net” bag) within a larger fermentation mass, The size of the mesh bag can be adapted according to the amount of beans available, and the technique has been used successfully for samples ranging from approximately 200g to 3000g, though samples of approximately 750g to 1000g are typical. It is important to keep the surface area to volume ratio of the fermentation mass constant and this can be achieved with heaps, baskets or fermentation boxes of at least 50 kg capacity. Baskets made of woven rattan with dimensions of approximately 38-50 cm diameter by
48 cm deep, can be used for this purpose. Good results have also been obtained using inverted plastic laundry baskets of similar dimensions which have had their bases removed and been strengthened with rattan hoops. Fermentation boxes 60 x 60 x 60 cm (200 kg capacity) or 90 x 90 x 90 cm (700 – 900 kg capacity) can also be used.

These should be made of suitable nonresinous, hardwood with slats with gaps large enough to allow drainage of the fermentation exudates (known as “sweatings”) whilst small enough to prevent beans from passing through.

The bean sample for evaluation must be placed in labelled bags, made of an inert material such as nylon or polyethylene with no metal parts, and are of approximate size 20 x 35 cm to allow a layer 2-3 beans thick when spread flat in the fermentation box. A mesh size opening of 10 mm mesh allows good contact between the sample and the fermentation mass and the thread diameter should be 0.7 mm or greater for strength. As a cautionary point, there could be a risk of flavour transfer from the fermenting mass to the micro fermentation in the mesh bag. This possible fermenting mass effect could be overcome by using similar varieties for the fermenting mass as the sample in the mesh bag and/or by using a finer (<10 mm) mesh size opening.

It is important that each mesh bag is not overfilled and that there is enough spare capacity to allow the bag to be held at each end to facilitate turning. The label on each mesh bag must contain information relevant to the sample such as (but not limited to) the clone name, the date of the start of fermentation etc.

Mesh bags should be buried in the top 15 – 20 cm of the fermenting mass ensuring that each bag is at least 5 cm from the wall of the box and separated from other bags by at least 3 cm. A maximum of two layers of bags, with four bags per layer, can be included but there must be at least 3 cm of fermentation mass between the layers and the top layer must be covered by at least 5 cm of beans. The top of the fermentation must be covered by at least two layers of banana leaves and then two layers of food grade jute bags for insulation.

The first turning is done after 48 hours by removing the jute bags and leaves, then transferring the top of fermentation mass into a food grade plastic box or bucket. Each layer of fermentation mass and mesh bags as well as the bottom layer of the fermentation mass are placed into separate plastic boxes or buckets and are thoroughly mixed. The beans in the mesh bags are mixed by holding the ends of individual bags in each hand shaking them from left to right a few times. The layers of beans and mesh bags are replaced in reverse order so that the top layer moves to the bottom and the bottom layer is at the top, whilst the central layer remains in its original place, and the mass is recovered with the banana leaves and jute bags. The second turning is done after 96 hours by repeating the process and the optimal end point determined by visual assessment of the beans as described above.
**Styro-cooler Fermentation**

Styrofoam coolers of dimensions 27 cm (L) x 26 cm (W) x 17 cm (D) or 44 cm (L) x 28 cm (W) x 29 cm (D) respectively are a convenient way to ferment small (between 15 – 30 kg) bean quantities from the same variety or a defined mixture of varieties. Styrofoam coolers are relatively cheap and easily available in most countries. Six to eight holes evenly spaced at 4 cm and of diameter 1.5 cm are made on the underside to facilitate the drainage and aeration of the fermenting mass. It is recommended that the coolers (regardless of size) are placed off the ground (on small blocks of wood) to allow for optimal drainage and aeration.

New coolers can be inoculated artificially with a defined micro-floral matrix at particular time intervals, scrapings from a used fermentation box (preferred) or left to be naturally inoculated by fruit flies. Inoculation from a used fermentation box is achieved by taking scrapings from the inside top and bottom surfaces and mixing in double the volume of water (distilled water is best) to create a paste. This paste is thoroughly mixed into the wet beans when they are filled into the cooler at the start of fermentation to evenly distribute the inoculum from the used fermentation box throughout the fresh wet bean matrix. This is then covered with banana leaves and the matching Styrofoam lid to retain the heat given off during fermentation. The beans are generally turned by mixing well after 48 hours and 96 hours and the optimal end point is determined by visual inspection.

**Recommended application of fermentation methods**

The method chosen from the options provided above should be appropriate to both the quantities of wet bean available as well as the objectives of the study. The styro-cooler method is used for homogenous or defined bean masses and takes more beans than the batch insert micro fermentation method. The batch insert micro fermentation allows more samples to be processed but requires larger fermentation masses (mother heaps/boxes) to insert the mesh bags into. There is also the potential risk of some flavour transfer from the larger fermentation mass. Single pod micro fermentations handle small quantities without contamination but suffer from the lack of averaging a larger number of pods. Each method used therefore has advantages and disadvantages which must be considered and weighed against the benefits derived from using a particular method.

**Drying**

The beans should be carefully and thoroughly dried. Where the batch insert micro fermentation method has been used, the samples can be dried in their mesh bags though care should be taken that the beans are not spread in a one bean thick layer on a drying tray, since this would result in drying at too fast a rate due to full exposure of all beans both to air as well as to the sun. Samples from Styrofoam container fermentations should be dried in small heaps. All samples, including those in mesh bags, should be heaped up at night to allow moisture levels to equilibrate.
It is essential that when many samples are being prepared at the same time (such as with multiple batch insert micro fermentations) they are not mixed up during drying and trays with individual labelled cells or separations can be used to minimise this risk. The optimal end point of drying should be between 6.5–7.8% moisture content as assessed by a suitably calibrated moisture meter.