

Primary processing of high quality Trinidad and Tobago cocoa beans – targets, problems, options

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Abstract

Trinidad and Tobago is an exclusive producer of fine or flavour cocoa and is regarded as the center of origin for Trinitario germplasm. Cocoa from Trinidad and Tobago, when optimally processed, possesses interesting fruity, mildly floral, winey even raisiny overtones with mild acidity which are quite distinct from those found in bulk cocoas. These flavour attributes are sought after and ensures that cocoa from Trinidad and Tobago receives a premium well above the international market price for bulk cocoa. In this paper, the concept of quality is defined and discussed in the context of a series of inter-related steps as they pertain to the post-harvest (primary) processing of cocoa, where each step in the production process has the potential to affect quality. Problems arising from following sub-optimal practices at each step in the production process are also discussed with a number of options for the primary processing of high quality Trinidad and Tobago cocoa.

Introduction

Cocoa has played an integral part in the history, culture and economics of Trinidad and Tobago especially after the island was opened up for plantation development in the 1780's. Towards the turn of the 19th century, cocoa came into its own displacing sugar as the major agricultural export from the islands. The value of cocoa exports from Trinidad and Tobago in the first 20 years of the 20th century doubled that of sugar and Trinidad and Tobago gained a reputation as an exclusive producer of high quality fine or flavour cocoa beans. Both buyers and manufacturers speak proudly of the distinguished marks from selected plantations in the 1950's and 1960's. The superior quality and unique "fruity/raisiny" flavour of cocoa from Trinidad and Tobago results from a unique blend of Trinitario germplasm, coupled with optimal post-harvest processing techniques. Trinidad and Tobago remains a source of fine or flavour cocoa and continues to receive significant premiums above the world market price for bulk cocoa. The demand for beans from Trinidad and Tobago currently exceeds present modest production levels.

Definition of quality and cocoa quality

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In the broadest sense of the word, “*quality*” may be considered as a specification or set of specifications which are to be met within given tolerances or limits (Kramer and Twigg, 1970). More commonly it is thought of as attaining a degree of excellence and the Concise Oxford dictionary defines “*quality*” as “...*possessing a degree of excellence...and to be concerned with the maintenance of high quality...*” (Oxford, 1980).

In the context of cocoa, “*quality*” is used the broadest sense to include not just the all-important aspects of flavour and purity, but also the physical characteristics that have a direct bearing on manufacturing performance, especially yield of cocoa nib (Biscuit, Cake, Chocolate and Confectionery Alliance (BCCCA), 1996). The different aspects or specifications of quality in cocoa therefore include: Flavour, Purity or wholesomeness, Consistency, Yield of edible material and Cocoa butter characteristics. These are the key criteria affecting a manufacturer’s assessment of “value” of a particular parcel of beans and the price he/she is willing to pay for it.

The Model Ordinance of the International Cocoa Standards defines that cocoa of merchantable quality must be: “(a) *Fermented, thoroughly dry, free from smoky beans, free from abnormal or foreign odours and free from any evidence of adulteration. (b) Reasonably uniform in size, reasonably free from broken beans, fragments and pieces of shell, and be virtually free from foreign matter*”.

When these definitions are applied to cocoa, no matter what the genetic origin, the flavour potential of each marketed fine or flavour and bulk variety can only be expressed by appropriate and adequate post-harvest processing. These principles are true for whatever germplasm is being processed and the objective if this paper is to examine strategies for the optimal processing of Trinidad and Tobago cocoa.

Steps involved in primary processing

The following outlines the steps in cocoa processing:

Harvesting

The development of the pod takes 5 – 6 months from fertilisation of the flower to full maturity. For optimal processing only ripe, un-diseased and undamaged pods are harvested. Pods are cut from the tree with a special knife fixed on to a long bamboo pole, taking care not to damage the pods or the tree and flower cushion.

Pod breaking

Pod breaking or opening is not a minor operation that merely consists of breaking open the pods and removing the beans, since it strongly effects subsequent operations, ultimate bean quality and conversion yield of wet beans to dry beans.

After harvesting, pods are either broken by means of a small cutlass or a wooden billet. The pod is struck halfway across the longitudinal axis and opened by twisting the tip of the cutlass. This is done in one fluid motion. Opening using the wooden billet involves

one or two sharp blows with the edge of the billet. The distal portion of the pod falls away and the beans remain conveniently attached to the placenta from which they can be easily extracted.

The beans are removed from the placenta being careful to exclude any germinated, black or diseased beans or pieces of shell and placenta fragments.

The time between harvesting and opening the pods have been found to influence subsequent fermentation and ultimate flavour development. In Trinidad, it is the practice to harvest pods at the start of the week and crack the pods in the field at the end of the week, fill bags or baskets with the wet beans and transport them to the fermentation facilities. The wet beans should reach the fermentation facility within 24 hours of the pods being broken to avoid any problems during fermentation. Pod storage in excess of six days has been found to affect flavours in cocoa (Clapperton *et al.*, 1994).

Fermentation

Fermentation boxes should be constructed of a suitable local hardwood in dimensions typically 1.2 m × 1.2 m × 1.2 m. They should be constructed in such a way that the heat evolved during fermentation is conserved and liquids produced during fermentation can freely drain away. The floors of the sweatbox should therefore be either slatted with spaces of about 5 mm between slats or drilled with 10 mm holes spaced 25 mm apart. A sweatbox of these dimensions can hold between 900 – 1000 kg of wet cocoa when filled to a height of approximately 0.75 m. Sweatboxes should ideally be built with a double wall in which the space between the internal and external walls of a side are filled with either sawdust or sugar cane bagasse for improved insulation.

Fermentation should begin less than 24 hours after the pods have been cracked and the beans extracted. Ideally, beans should be placed in the fermentation boxes on the same day that they are received. The wet cocoa beans should be covered in the box with fresh banana leaves and jute sacks to insulate the top of the box. Plastic should not be used. Covering conserves the heat evolved during fermentation.

Fermentation usually lasts between 6 – 8 days depending on weather conditions and time during the cocoa season. Fermentation usually takes longer at the start and peak of the cocoa crop but shortens towards the end of the crop when there is less mucilage available for fermentation. Initial turning during fermentation is done after 48 hours and an additional turning 48 hours thereafter to facilitate adequate aeration of the fermenting mass and to ensure that beans from the top and bottom are thoroughly mixed together. A fresh layer of banana leaves can be added to the original banana leaves after each turning to ensure adequate insulation.

The optimal end of fermentation can be checked from the end of the 5th day by cutting a sample of beans longitudinally. The inner surfaces of the beans should show well defined ridges and the colour inside should be light pink to brown and the outer edge of the cotyledon should have a dark brown colour. Temperature during fermentation

usually peaks after the second turning (around the 5th day of fermentation) and should reach 47 – 49°C.

Drying

At the end of fermentation, the moisture content of the whole bean is approximately 60%, and this must be reduced to 7 – 7.5% before the cocoa can be stored, sold or transported. If the moisture is reduced too much, the shells become too brittle and break. If moisture is too high, mould growth occurs during storage.

The rate of drying is critical to final quality. Too rapid a drying rate results in excessively acid beans with case hardening (shriveling). Sun drying is carried out on wooden floors in “cocoa houses”, artificial dryers can be used or a combination of sun and artificial drying.

For sun drying, freshly fermented beans are spread on the floor of a cocoa house each day to a depth of not less than 5 cm and mixed regularly by walking through the layer of beans making small ridges and furrows.

At the start of the crop season when there is more residual mucilage around the bean after fermentation, the beans are banked in two long rows in the centre of the floor for the first night to complete the fermentation process and spread out on the floor of the cocoa house the next morning for further drying.

Artificial drying is commonly used after sun drying has reduced the moisture content to approximately 20%. A large mechanical dryer usually comprises a diesel burner with a blower. This blows hot air through a plenum onto the base of a wooden drying bed. The hot air passes through 8 mm holes drilled in the wooden floor through an 8-10 cm layer thickness of cocoa beans. The beans are spread out on the floor to a depth of not less than 5 cm and turned regularly with wooden rakes or paddles to ensure even drying.

Typically, artificial dryers in Trinidad and Tobago do not have heat exchangers to prevent contamination by direct contact with smoke in the heated air from the diesel burners. This makes it essential to service diesel burners regularly to prevent smoke and diesel fume contamination. Even though well maintained diesel burners may not contaminate beans with smoke, there is still a risk, and the installation of heat exchangers to remove this risk of smoke contamination should be considered.

In an alternative design, the dryers may comprise 6 arms which radiate from the centre of the dryer fixed to an annular ring which functions as a large cog, the stirring mechanism is driven from the edge. The arms carry strips of wood inclined downwards to facilitate stirring. Hot air is directed into the drying chamber from under the platform through holes drilled at the base of the circular platform.

Polishing

During drying the beans are polished to improve their appearance. The beans are polished at a stage where they are hard but not brittle in a rotary type dryer described above or a special polishing machine similar to a grain mixer. Polishing improves

external appearance of the beans and it is suggested that polishing protect the beans from fungal infestation during storage.

Cleaning and Bagging

After drying and polishing, the beans are cleaned of any extraneous matter and packed in food safe jute bags. New food safety requirements dictate that “food safe” bags whose fibers have been treated with vegetable oil must be used to store cocoa beans. These bags are only used once and must also be clean, sound, sufficiently strong and properly sewn.

Grading

Grading is done via a mechanical grader which uses a gradation of different sized mesh sheets around a rotating cylindrical drum with helical screw inside to convey the beans. During grading, first broken pieces of beans and shell fragments are removed, next flat beans are removed, then small beans and finally large Grade I beans. There are 3 grades of cocoa beans established by the Cocoa and Coffee Industry Board: Grade I, Grade II and Defective. Grade I has a bean count of 85/100g, less than 1% commercial defects (that is, in order of importance, mouldy, over-fermented, smoky, under-fermented or insect infested beans). Grade II accounts for just 5% of the total cocoa crop and either has a bean count of 85/100g with less than 4% commercial defects or a bean count of 100/100g with less than 1% commercial defects. Defective beans are not exported.

A well-fermented and dried Trinidad cocoa bean is plump in appearance and when cut shows a chocolate brown cotyledon with clearly defined internal ridging. No mould or insect damage must be present.

Storage

The great care to achieve optimum quality from harvest to drying must continue during transport and storage. There must be proper humidity control to avoid re-humidification of the beans, which would lead to mould growth. Also, storing on gratings or decking should allow at least 7 cm air space above the floor to avoid rodent and insect pests. Storage must also not be in close proximity to any strong odours. In Trinidad, cocoa is never stored for a significant period of time before shipment; thus reducing the chance of picking up strong off odours, increased moisture levels and mould growth. Forced air ventilation, fumigation and good phytosanitary practices all contribute towards optimal storage conditions.

Quality problems resulting from sub optimal processing

Failure to follow the recommended practices in any one of the processing steps mentioned above can result in sub-optimal or poor quality.

Commercial cocoa varieties that have not been properly managed and/or very old trees may have poor yields and smaller pods and beans. Harvesting immature, diseased or damaged pods provides poor quality raw material for fermentation. Inappropriate harvesting techniques may also damage the flower cushions and reduce future yield from the trees.

Sub-optimal fermentation may result from too long a time from pod opening to fermentation, small quantities of beans, inappropriate methods of fermentation, duration and turning regime. All of these factors will have negative effects on bean quality. This coupled with sub-optimal drying with respect to temperature/time and turning regime, or the drying method, or the influence of poor weather conditions will also have negative effects in bean quality. Poorly maintained diesel burners on artificial dryers with no heat exchangers can contaminate well-fermented cocoa and make it unusable.

Storage of fermented and dried cocoa beans must prevent re-humidification or infestation by rodents and insects. Also, storage must be free from strong odours such as from diesel, gasoline and chemicals (herbicides or pesticides) or even copra (dried coconut) since cocoa beans can be easily tainted with these odours.

Options for processing

Fermentation

The principles governing processing for high quality have been well established and tested over time and deviations from these practices can adversely affect quality. There are however some options for processing that are available and can be recommended based on local needs and circumstances. The sweatbox method of fermentation is recommended for Trinidad and Tobago. However, some farmers may not have the adequate quantity of wet beans to fill a sweatbox of the dimensions mentioned earlier. In such circumstances smaller sweatboxes capable of holding at least 75 kg of wet beans have been constructed or basket fermentations with adequate drainage, aeration and insulation with similar quantities are possible with little adverse effects on quality (Sukha, 1997). In situations where farmers have less than 75 kg of wet beans per batch, this should be sold to a central fermentary for processing. Currently there is one operational central fermentary in east Trinidad but more are planned at different geographic locations in Trinidad in the near future. The idea of central fermentaries is not new and has been successfully implemented in Grenada and Jamaica. Central fermentaries reduce the workload of farmers and help provide consistency and uniformity to cocoa processing. Nevertheless they may present some social, logistical and infrastructural challenges to operators and managers.

One such challenge is to determine a fair price for wet cocoa taking into account the cost of processing and yield of salable dry cocoa (wet to dry conversion ratio). Payment options for wet cocoa based on volume would be fairer than payment based on weight since the moisture content of pods varies at different times of the year. These issues should be explored and discussed with farmers to agree.

Drying

Sun drying of cocoa beans is inexpensive and best for optimal quality. However, it is subject to the vagaries of weather that can adversely affect quality and can restrict throughput during peak crop periods. Sun drying with a source of indirect heat to prevent

or limit mould growth in the event of continued wet weather is a feasible drying option worth exploring.

A combination of initial sun drying until about 20% moisture content, followed by artificial drying to obtain a final moisture content of 7.5% is a feasible drying option commonly applied in Trinidad. This satisfies the mild drying rate needed at the start of drying and the throughput requirement during peak crop period.

Mixed mode artificial dryers, incorporating a solar collector and blower and gas-fired burner with a heat exchanger have been developed at UWI. These dryers offer the flexibility of either fully utilising the sun for drying during good weather with air flow assisted by a blower or a clean burning gas fired burner with a heat exchanger for full or partial artificial drying. The solar collector in this mode preheats the inlet air thereby reducing excessive and unnecessary heating by the burner. In any artificial drying application using indirect heating from either diesel or gas burners, a heat exchanger is used.

Conclusion

Trinidad and Tobago enjoys an enviable position as an exclusive producer of fine or flavour cocoa with a rich history and good reputation for high quality cocoa. The importance of maintaining a consistently high standard of quality of cocoa beans cannot be over emphasised. The chocolate made from Trinidad and Tobago premium fine or flavour cocoa beans, sells in a very competitive market where high quality and value are paramount. If the quality of the cocoa beans is poor, the final products suffer and the industry as a whole loses. It is vital therefore that everyone involved in the industry, from growers, marketing boards to manufacturers, does everything possible to maintain and improve standards of quality. Excellence in quality starts with the selection of suitable germplasm and optimal primary processing realises the genetic flavour potential of the germplasm used this continues through to secondary and further processing. All parties in the “cocoa chain” have their part to play in ensuring that consumers of chocolates and also premium chocolates made from Trinidad and Tobago cocoa are provided with a product that is safe, wholesome, full of flavour and most enjoyable to eat.

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