Cocoa Processing & Chocolate Manufacturing

Products derived from cocoa (Scientific name: *Theobroma cacao*) are some of the most widely used eatables amongst the food-based consumer goods. While it all tastes delicious to have a chocolate bar regularly or once in a while, there's little factual information available to the masses regarding the origin, processing, and handling of cocoa and products derived from it. So, lets us talk about how the cocoa beans are taken out from the cocoa pods and unit operations in their handling.

Post-harvest handling of cocoa beans:

Like all the other kinds, cocoa seeds are also found inside an outer covering- the cocoa pod. Cocoa seeds are commonly called cocoa beans and are found in bunches of 30-40 within each cocoa pod. Each tree produces about 20 pods consisting of melon-shaped seed pods attached to the cocoa tree. In addition, cocoa pods need due care and cannot wait for more than 4 days to open up. The pods are hit with a thick wooden stick, the seeds are taken out and carried in a basket to a dry spot. The leftover broken husk on field can be used efficiently for making compost. From harvesting to processing, the handling of the pod has been listed below

- **The high-grade (Criollo cocoa):** The beans are large, delicately bitter, and brownish in color. They are processed easily.
- **Common grade (Forastero cocoa):** The beans are comparatively smaller than criollo beans have reddish to purple color with a strong flavor. They account for 90% of all the cocoa beans harvested in the world.

Chocolate manufacturing:

1. **Fermentation of cocoa beans:**

After grading and sorting, beans are fermented enzymatically or microbiologically to attain the alluring cinnamon or reddish-brown color. Conventionally it may be done by heaping the beans in a pyramidal formation and covering the heap with banana leaves. Characteristics of plant seeds, cocoa beans also contain the seed kernel and the germ which are destroyed during fermentation.

The action of micro-organisms: It starts with the growth of micro-organisms, in particular-yeasts. The pulp surrounding the beans contains sugar, which is converted into ethanol by yeast. Further, bacteria take over and convert this alcohol into acetic acid and then to carbon dioxide & water producing more heat in the process and raising the temperature. This breaks down the pulp and it starts to drain away soon. The temperature is raised to 40 to 45 degrees Celsius during the first 48 hours. The process of turning and mixing or stirring the heap increases aeration and hence bacterial activity.

Death of cocoa beans: By the second day of fermentation, the high acetic acid and temperature cause the cell walls of the cocoa beans to break down and brings about several complex chemical changes such as enzymatic actions, oxidation, and conversion of protein into amino acids. This is called the death of the cocoa bean. These reactions cause the change in color and develop the chocolate flavor.

Modern fermentation: These days, the fermentation is also done with the help of boxes with holes at the bottom so that the unwanted juice runs off through bottom holes. Then after two days, the box needs to be taken out, stirred, and put into another box. This process ensures uniform fermentation along with proper aeration and is repeated for 8 to 10 days, after which the fermentation is completed.

Drying: The next step of drying the beans is a crucial one, which takes about 5 to 10 days. For good keeping quality, a 7% moisture content is generally preferred. Badly dried beans yield poor grades and will never get you a good profit! Finally, the beans are sorted based on different standards and packed in sacks accordingly.

The fermentation process as discussed above is the first step in chocolate manufacturing. The immediate cocoa-based products are chocolate liquor, cocoa butter, and cocoa powder. These products, though similar in their fundamental essence, differ in their fat and carbohydrate compositions.

2. **Winnowing:**

The process of winnowing is equally important- usually when the outer skin of the cocoa bean is removed after fermentation, what is obtained is known as the cocoa nib. Now, to convert these nibs into mouthwatering chocolates, they are ground into fine pieces. Cocoa nibs contain edible substances – Caffeine.

3. **Roasting:**

Nibs are roasted in between 105-120 Deg. C in ovens depending upon the end product for which it shall be used. Roasting gives the characteristic dark brown color as well as its chocolaty flavor & aroma.

4. **Grinding:**

To obtain the chocolate liquid, also known as mass, roasted nibs are milled. Mass is used as the primary component for the production of any cocoa derived product.

5. **Blending:**

Manufacturers use chocolate liquor, cocoa butter, sugar, and a minor quantity of vanilla beans, all combined together and then subjected to refining by passing through close-clearance revolving rollers. According to the end product desired, different blends are taken as follows:

- For Dark chocolate: sugar, cocoa butter, cocoa liquor, and (sometimes) vanilla are blended.
- For Milk chocolate: sugar, cocoa butter, cocoa liquor, milk or milk powder, and vanilla are blended.
- For White chocolate: sugar, cocoa butter, milk or milk powder, and vanilla are blended.

Packaging and Transportation:

For packaging of cocoa beans, usually, jute bags of 60-65 Kg are used which are then transported through the ship, railroad, or trucks. Ideal condition to be maintained during handling or transportation is the temperature between 15- 30 ˚C and relative humidity of 70% – 75 % along with a water content of between 6 to 9%.

Major products manufactured from Cocoa beans:

1. **Cocoa butter** is a high fat containing product obtained after the fermentation process. It is the main cause of fat bloom in chocolates. Cocoa butter forms about 50-57% of the cocoa beans and gives chocolate its characteristic melting properties.

2. **Cocoa powder or dry cocoa solids** are obtained after a defatting process of chocolate liquor using a mechanical or a hydraulic press. It can be used in almost any food product as an ingredient or as a garnish. For example, Cocoa powder is used in cakes, mousse and ice-cream, biscuits, and many confectionaries. It also forms the basis of chocolate's flavor.
3. **Chocolate liquor** is obtained from cocoa beans that have been fermented, dried, roasted, and separated from their skins. The beans are then ground into a cocoa mass followed by melting into cocoa liquor.

Tabel 1. Nutritional composition of the cocoa products

Product	Total proteins in %	Total fat in %	Total carbohydrates in %
Cocoa Butter	0	57-64	0
Cocoa Powder	40	8-26	19
Chocolate liquor	11	53	17

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4. **Chocolate** is produced by blending, conching, and tempering of the above-mentioned cocoa products. There are different kinds of chocolates manufactured in the market such as White chocolate, Dark chocolate, Milk chocolate, Ruby chocolate, and many more varieties in different parts of the world. The nutritional composition of chocolate varies based on the type of chocolate manufactured. Given below is the detailed process description of manufacturing a chocolate bar.

By-products of Cocoa processing and their uses:

- **The husk** of the cocoa pod is used for producing animal feed. The feed is produced by slicing the husk into small flakes and then letting them dry partially. This is followed by mincing, pelleting, and drying of the pellets.
- **Cocoa pulp juice** is used in the production of soft drinks and alcoholic beverages. The fresh cocoa pulp juice, called sweating is collected, sterilized and bottled. For the production of alcoholic drinks such as brandy, the cocoa pulp juice is boiled, cooled, and fermented by yeast, which is then distilled after 4 days.
- **Pectin extracted from the cocoa juice**, which is then precipitated with alcohol followed by distillation and is used in the production of jams and marmalades