PROCESSING, QUALITY ASPECTS AND PRODUCTION OF PRODUCTS

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Cocoa is the most popular food flavour consumed all over the world. It fulfills two primary functions in foods - as a colorant and as a flavor ingredient. In many cases, the flavour function dominates. In practice, this double role has led to a wide range of cocoa powders adapted to applications in a very large range of foods. The attraction of this bitter and most popular natural food clearly lay in the physiological effects it offered the consumer. The fact that cocoa is chemically very complex and that many of its components have not been fully identified confirms the complexity of this natural bean's biochemistry.

The quality of Cocoa beans is analyzed under various parameters:

- Degree of fermentation
- Number of defects
- Number of broken beans
- Bean count (number per 100 g)
- Flavour
- Colour
- Fat content
- Quality of fat
- Shell content
- Moisture content
- Uniformity
- Insect and rodent infestation
- Certain chemical residues

The ideal method to evaluate the degree of fermentation and the defects is bean cut test. The first and the most important criterion is flavour. It is necessary to develop an expert panel for the grading of cocoa beans by identifying the cocoa flavour and undesired off-flavors. The quality of bean varies depends on the type of bean and post harvest, fermentation and drying conditions. Moldy off-flavours come from molds; smoky taints may come about during drying; acidic off-flavours are due to excessive acid created during fermentation or improper drying. Off flavours can also be caused storing the beans in the proximity of another strong-smelling product or environment. The higher the moisture content, the higher the chances of mold development. The % fat content, the amount of foreign matter, broken beans will play a vital role in deciding quality of cocoa beans.

The degree of fermentation of the cocoa bean is therefore considered of paramount importance.The cut test is used to determine the degree of fermentation of the bean. In this test, each bean out of a sample of 300 beans is bisected, and the color of the interior of the bean is assessed by counting the percentage of slate-colored and violet-colored beans. Slaty beans are not fermented, and violet beans are incompletely fermented. Non-fermented beans do not lead to cocoa flavour development.

Cocoa beans can also be over fermented. In this case, the beans begin to decompose, and the pH rises sharply as proteins in the beans start to break down. During this process, very dark pigments are formed. They are reaction products of flavonoids with amino acids. The beans are then very dark coloured and brittle. Over fermented beans lead to a hammy off-flavor.

The raw material Standards

Certainly the condition of the starting material, the cocoa bean, determines the ultimate

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characteristics of the end products.

An average shipment of cocoa should comply with the following:

- Fermentation - adequately fermented
- Foreign matter - nil
- Waste – Less than 2%
- Moisture content - Less than 7.5%
- Smoky or foreign odors - absent
- Bean size - reasonably uniform
- Packing weight, bag quality, and marking – as specified

These standard characteristics, applied in the various grading systems in the countries of origin, are generally limited to those that can be felt by our sensory organs. (insect infestation, moldy, slaty, violet, or flat beans, off-flavours) and characteristics that can be analysed using simple equipments (number of beans per 100 g, moisture content, pH).

Process control

Fluctuating bean characteristics

Cocoa is a natural product and quality variations do occur like any other agricultural commodity from country to country and lot to lot. The cocoa bean processor expect to receive a consistent final product, the fluctuation of quality characteristics of end-products has to be eliminated or reduced to an acceptable level. So it becomes necessary to blend the cocoa beans of different categories, the processing conditions are to be adapted based on experience and technological expertise suiting the properties of the raw material. Therefore, the processing of cocoa beans into wholesome, safe, and consistent cocoa ingredients requires.

1.The quality of the cocoa beans- The cocoa beans are to be well-fermented and clean.

2. The production process -The process must be carried out according to the controlled conditions with strict hygienic standards (Fig.1), the roasting and alkalization stages can be adjusted to the specific characteristics of the desired quality requirement. The variations in colour, pH, flavor of cocoa powder can be achieved. It is also most important to meet the customer specifications with respect to bacteriological quality.

It is very essential to prevent the post contamination after the roasting step to by maintaining aseptic conditions till the product is sealed in suitable containers. For this reason, processing in accordance with the principles of Good Manufacturing Practices (GMP) is indispensable.

Roasting

The roasting process is of great importance for the ultimate flavour profile of the end product. The roasting step is also important because it allows the manufacturer to influence the flavour development to a significant degree. By adapting the roasting conditions, a variety of flavor profiles can be obtained for cocoa liquor, the base flavor component for chocolate and cocoa powder.

Chemistry of roasting

Most of the various compounds found in the flavour of cocoa are generated by the Maillard reactions. The aldehydes and pyrazines in particular, are considered to be important for the character of cocoa flavor. The Maillard reactions play a major part in all food preparations in which the flavor is developed by a heating process like baking, frying, or roasting. It is essentially a reaction between a reducing sugar like glucose

or fructose with an aldose-group and a compound with an amino-group.

Alkalization

In the manufacture of cocoa powder, alkalization has a number of distinct benefits. It will influence both the colour and the flavour of the end product. In the alkalization process, the cocoa is treated with an alkaline solution. A number of different alkalis are permitted and the process conditions can vary or in the cocoa cake/ powder. Literature reveals little of the numerous and complicated chemical reactions taking place during alkalization. Flavour aspects like typical cocoa and bouquet are enhanced and intensified during the process. Among other criteria are the kinds of beans, the type and quantity of alkali used, ratio of the active ingredients, time, and temperature. The typical cocoa Flavour aspects are enhanced and intensified during the process.

Development of cocoa colour

The formation of the colour of cocoa passes through a number of stages. It starts with the formation of precursors by biochemical processes that take place in the cocoa beans during the growth and ripening of the fruit on the tree. This process is largely determined by the bean varieties, disease stress and the climatic conditions during growth. The next stage takes place subsequent to harvesting during fermentation and drying of the beans. This is a very important phase, as it is here that the characteristic brown colour of cocoa is formed.

The ultimate colour of cocoa, however, is reached after further processing of the beans, where alkalization is the critical step. Depending on the process conditions and the alkali used, the initial yellowish-brown colour develops into a

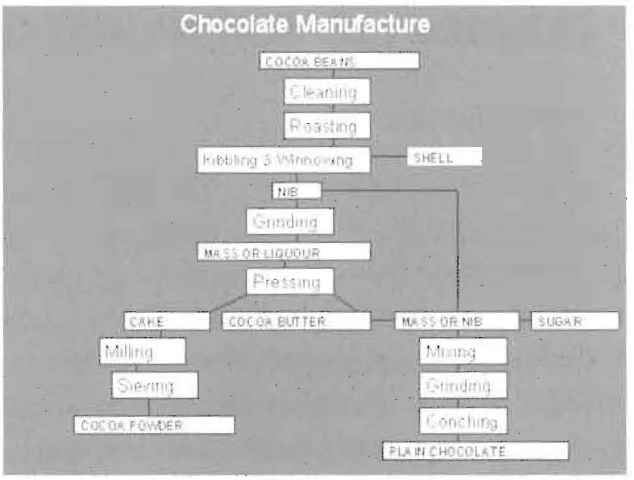

Fig.1 Processing cocoa beans and production of products

variety of hues from light brown to red or even black. Controlling the influence of the various stages of production on the color development of cocoa powders is complicated and difficult. Precursors of the color component Flavonoids, a sub-group of polyphenols, are the primary precursors of the pigment in cocoa. They occur widely in the plant kingdom.

Fig.1. Processing cocoa beans and production of products

Flavour of cocoa

The flavour of cocoa is assessed by sensory evaluation. It is an individual's judgment of a taste or smell of a food product. Because it is largely a subjective process, it must be transformed into an objective assessment to be of use to a food manufacturer in the areas of new product creation or improvement and quality control. In essence, flavor evaluation is a tool with which a food processor is able to convert the subjective judgment of consumers into measurable data from which an objective analysis can be made. The flavour of Cocoa is evaluated by trained panel members under standard conditions, using a positive standard sample as a reference.

General test conditions

For effective flavour evaluation, a trained panel of five to eight members is necessary, and test conditions must be standardized the composition and the formation of the cocoa flavour components. More than 480 different volatile components divided among some 20 different chemical classes have, to date, been identified in roasted cocoa, making it one of the most complex flavours known to mankind.

The most important factors in the formation of the cocoa flavour are:

- Cocoa bean variety
- Fermentation and drying
- Roasting
- Alkalization

The flavour of the Forastero was less appreciated by chocolate manufacturers. In trying to combine the advantages of the Forastero and the fine flavor of the Criollo, new hybrids were cultivated. These are known under the variety name of Trinitario. Each bean variety has its own specific potential flavour profile. However, growing conditions like climate, amount and time of sunshine and rainfall, soil conditions, ripening, time of harvesting, and the time between harvesting and fermentation of the beans all contribute to the flavour formation. During fermentation, enzymatic reactions play a principal role in the formation of the cocoa flavour precursors. Peptides and amino acids are generated by enzymatic breakdown of proteins. Sugar from the pulp is split into glucose and fructose. The peptides and amino acids and reducing sugars are the later stages of the processing of the cocoa beans.

Cocoa Butter

Cocoa butter is one of the most expensive commodity-based vegetable fats available in the market today. It is obtained by pressing of finely ground cocoa liquor in a hydraulic press. The chocolate industry is almost the sole user of cocoa butter, and usually press cocoa butter is set as the standard.

The factors enhancing the quality of cocoa butter are:

- Use of sound cocoa beans to obtain cocoa butter with max. 1.5% of free fatty acids (FFA)
- Reduction of shell content in the cocoa nibs (max. 1.75% on alkali-free nibs),
- Processing like filtering and/or centrifuging, degumming and/ or deodorizing, neutralization, and bleaching.

Flavour characteristics of Cocoa Butter

The flavour intensity of cocoa butter can be managed by subjecting it to a deodorizing treatment. Depending on the required flavour intensity, cocoa butter can be fully or partially deodorized. A taste panel can help establish to what degree of deodorization the cocoa butter.

In creamy milk chocolate, which contains much smaller quantities of cocoa liquor in combination with higher quantities of cocoa butter and has a flavour profile that usually avoids strong and bitter notes, fully deodorized cocoa butter is often used. In white chocolate, which contains no cocoa liquor at all, the type of

Fig.2 CAMPCO Chocolates

cocoa butter will heavily depend on flavour profile and customer targets.

Chocolate

It is in 1847, John Fry discovered one of the confectionery industry's greatest inventions by adding cocoa butter to a mixture of cocoa liquor and sugar. Chocolate was born, and it was here to stay. Cocoa butter was the key to John Fry's chocolate invention. The overall taste perception of chocolate is, to a large extent, the result of a balance between the sweetness of sugar and the bitterness of the cocoa liquor. The degree of roasting as well as the origin of the cocoa can change the perception of the bitterness of the cocoa liquor substantially. Supporting flavour ingredients such as vanillin are often instrumental in rounding off the total flavour impression. The fineness of chocolate is an important factor in both the colour and the flavour of the product. The finer the chocolate, the lighter its color will be. As a rule, chocolate with a high liquor content is very finely ground. The different types of chocolates manufactured by CAMPCO is presented in Fig.2

Quality Assurance

The checking of the finished product is inevitable but the efforts are on the production process to maintain the best practices and the need for controlled processing and continuous checks throughout the production process. This goes beyond the hygienic aspects of quality assurance and is a step-by-step outline for the entire production process. Assessments of hazards associated with raw materials, processing, and transport are made. The physical, chemical and microbiological influences of the processing are considered in relation to food safety and quality. After hazard assessment, the Critical Control Points (CCP's) required to control the identified hazards are determined. For each CCP, critical limits, procedures for monitoring, and corrective actions in case of deviations are established and continuously monitored. Within HACCP, special attention must be given to prevention of contamination with Salmonella after the roasting process. Good Laboratory Practices (GLP) are essential for validation of data. On a regular basis, analysis of control samples must be carried out to evaluate the performance of the methods and the analysis. ●