Chocolate Processing Overview

Like wine, chocolate has mythological roots that are mixed with religion. Like fine cheese, it is a food with taste and texture dependent upon its fat content, flavoring and occasionally having been aged. And, like coffee, it is usually derived from a blend of roasted beans.

Unlike the others, though, chocolate is rarely taken seriously, being regarded instead as a dieter's indulgence or a child's treat.

But chocolate is indeed fascinating. Well-made and sensibly enjoyed, it is a food for the most philosophical gourmet, and its history is, in the best sense of the word, a romance.

So what does it take in our competitive industry today to go from cocoa beans to fine confections that consumers will want to buy again and again?

Let's begin with the consumer. After all, it is the consumer that is the ultimate judge of the quality of chocolate confectionery products. What do they want? What are their quality criteria? Obviously consumers are looking for a product that tastes good. A confectionery product must satisfy the desire for a treat. However, product appearance is also important due to the fact that 80 percent of our tasting is done through our eyes. Finally, consumers are looking for products that are reasonably priced and represent a good value.

Marlene Stauffer
Blommer Chocolate Company

It is the job of the confectionery manufacturer to listen to the consumers in order to produce products that they will find appealing.

These manufacturers dissect consumer expectations thus developing their own quality criteria. Some critical elements include: gloss retention, flavor, snap, bloom stability, ideal viscosity and cost. Starting with the best raw materials, equipment and operation expertise will enable the manufacturer to consistently produce quality products and to establish a loyal customer base.

There are many different suppliers of specific raw materials to manufacturers. This paper will be concentrating on chocolate suppliers. To supply chocolate to the confectionery industry requires certain quality criteria. A few manufacturers of confections make their own chocolate. However, the majority rely on outside sources to supply their chocolate needs. How does the supplier help the confectioner achieve the ultimate goal—a product desired by the consumer? The success of the supplier is dependent on the success of the confectionery manufacturer. How do they help each other attain the ultimate goal of pleasing consumers?

Let's look at the variables in the chocolate processing flow that can be controlled to meet the requirements of confectionery manufacturers.

RAW MATERIAL

Cocoa beans are grown within 20 degrees north or south of the equator due to the specific growing conditions required. Each growing region produces a bean type with its own unique characteristics of flavor, color, fat contents, and hardness of cocoa butter. The quality of the cocoa beans are dependent upon several factors including proper fermentation, drying, grading and transporting.

Chocolate manufacturers evaluate cocoa beans for bean size, mold, infestation, filth and degree of fermentation to ensure that only the finest beans make it into their facilities. This is the first critical step in ensuring a finished chocolate that will meet the quality criteria of confectioners. No processing steps can improve upon inferior beans.

Sugar is a primary ingredient used in the manufacturing of milk and dark chocolate. The particle size distribution of the sugar crystals is particularly important. The presence of excessive fine particles will require more cocoa butter to reach the optimum viscosity thus increasing the cost of the end product. Therefore tight specifications must be maintained.

Milk products vary among suppliers. Some milk products include: whole milk (spray dried and roller dried), nonfat dry milk, anhydrous milk fat, and milk crumb—a blend of sugar, milk, and chocolate liquor processed to have a caramelized flavor.

Lecithin is added to chocolate to increase its fluidity while minimizing the use of expensive cocoa butter. However, too much lecithin can cause the inverse to happen and the viscosity may increase.

Flavorings such as vanilla and vanillin are often added to chocolate to help enhance already existing flavor characteristics in the chocolate.

Presented at the National American Association of Candy Technologists Technical Session

Choices made here will affect the flavor, flow properties and color of the finished chocolate.

EQUIPMENT

Equipment used in chocolate processing is another variable to consider.

The goal in roasting is to achieve a clean, even roast with good flavor development. The most common methods of roasting are nib roasting and whole bean roasting. The roasting parameters are critical to determining the flavor and color of the chocolate liquor produced, and ultimately the chocolate that will be made from this chocolate liquor.

PROCESSING

Roasting

In nib roasting, nibs are roasted in a batch system introducing humidity to control removal of volatile substances, which enhances flavor development and to aid in the microbiological quality of the product.

In whole bean roasting, beans are commonly passed over a fluidized bed at a specific temperature and dwell time. The bean flow rate, bed depth and internal bean temperature are critical variables to be optimized.

Each roaster has its own unique design to impart different flavor characteristics for the chocolate liquor required.

Grinding

After the cocoa beans are roasted to the desired flavor profile, the nibs (meat of the cocoa bean), are then ground into chocolate liquor by a variety of types and combinations of grinding equipment. These include shear mills, ball mills and stone mills. Equipment chosen is dependent on its ability to achieve appropriate particle size reduction, fat release, flow rate capacity, energy consumption, design and cost.

Mixing/refining

We have come to the point in the process where the raw materials used to manufacture chocolate are mixed together, refined and conched. Typically, the mass is fed to roller refiners where the particle size is reduced to the required fineness. A refiner is a series of rolls which reduce particle size of the incoming ingredients through the use of differential roll speed causing sheer. Pre-refiners are often used to condition the mass prior to the five roll refiners. The mass is introduced to the lower roller and moves up the rolls increasing the surface area and causing a dry paste or flake to come off of the refiner.

Conching

The chocolate is then conveyed to a conche. Conches are large mixers that input large amounts of mechanical energy into the chocolate mass. The resulting friction causes a shearing action and a rise in temperature. Conches are time, temperature, and air controlled. Some of the benefits of conching are:

- improved rheology/reduction in viscosity—less cocoa butter needed
- elimination of harsh volatiles to give a more mellow flavor
- removal of moisture (reduces lumping and graining).

CONTROLLING THE PROCESS

The next variable to be discussed is the implementation of processing controls throughout chocolate manufacturing.

It is important to closely control roasting parameters in order to manufacture and develop chocolate with the desired flavor profile. With the use of computer monitoring for bean roasting formulations as well as trained operators, the quality assurance process controls are in place to roast the beans correctly.

With chocolate liquor, the fineness is often measured by a hand held micrometer by the operator on the production line. Further analysis of the liquor particles can also be performed by a particle size analyzer in the laboratory.

With the proper fineness and fat release of the liquor, the manufacturer will be able to produce a quality chocolate economically.

Controls in the mixing/refining area are of critical importance for the proper formulation of chocolate. Selecting the appropriate ingredients such as milk, chocolate liquor type, cocoa butter, and adding them correctly to the mixture will determine the final chocolate manufactured. Operators control the refining process and particle distance which contributes to the final fineness, color, mouthfeel and texture of the finished product using hand held micrometers (by the refiner operators) and a particle size analyzer (in the laboratory) to determine the particle size distribution. The less fine particles that are in the product, the less cocoa butter required to reach the optimum viscosity needed by the customer.

After the product is refined, the conching process takes place. Time, temperature and air flow are unique to each chocolate type and process. The control of these parameters will determine the outcome of the product, for example: harsh, mild or caramelized flavor. During the conching cycle, cocoa butter, emulsifiers (lecithin) or flavorings may be added. The timing of these ingredient additions can greatly change the final product characteristics in terms of flavor and handling.

The chocolate is now ready to be standardized for viscosity and fat content. During standardization, viscosity is typically measured using a viscometer in degree MacMichael or Brookfield units.

Different end uses for the chocolate will require different handling properties. The viscosity measurement will tell how thick or thin a product is.

Yield value and plastic viscosity will help evaluate the flow characteristics of the product. Yield value is the force required to start the flow of chocolate and plastic viscosity is the force required to keep the chocolate flowing.

Now we have made it through the chocolate processing and have a product ready for the manufacturer of the confectionery to make into his fine pieces. We have all the attributes necessary to guarantee a confectionery piece consumers will buy again and again.