Conquering Shelf-life Issues of Chocolate

Ingredients, processes, packaging and ambient conditions all affect shelf life. Understanding and controlling these factors will help to ensure product quality and encourage repeat purchases.

Marlene Stauffer
Blommer Chocolate Co.

All foods are perishable by nature. Numerous changes can take place in foods during processing and storage. Conquering shelf-life issues in confections can be challenging, to say the least. This paper will define shelf life and discuss issues directly impacting shelf life, such as formulation, manufacturing, storage and distribution, and then discuss possible remedies to overcome these issues.

WHAT IS SHELF LIFE?

The shelf life of a food product is the period of time during which it will retain acceptable appearance, aroma, flavor and texture. Key elements of shelf life for the confectioner are microbiological safety, eutetics, bloom, migration (fat or moisture), loss of texture and rancidity.

Chocolate is a high-energy foodstuff with a complex nutritional profile, containing fat (either cocoa butter or, if it is a confectionery coating, vegetable fat), carbohydrates and protein. It does provide some minerals and vitamins. It is an intimate mixture of solid particles suspended in fat. Chocolate is very shelf stable due principally to the unique properties of cocoa. Chocolate contains cocoa butter and, sometimes, milk or milk fat. It has a fast flavor release and melts at body temperature. Cocoa solids contain a natural antioxidant in the form of tocopherols, and cocoa butter breaks down to inoffensive short-chain fatty acids. As a result, most chocolate products can be classified as medium- or long-life products. Compound coatings contain vegetable fat, have a slower flavor release and can be heat resistant. When adding inclusions and making candies using chocolate, shelf-life factors can be altered and categorized into two main classes:

- Those which are inherent in the product itself and cannot be prevented by packaging alone.
- Those which are dependent on the environment and may be controlled.

In a perfect world, making mouthwatering confections today and selling them tomor- ➤

Marlene Stauffer is the director of quality assurance/research and development at Blommer Chocolate Company. She has been with Blommer since 1982.

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row is ideal, but many factors influence how these candies get to our consumers, such as raw material availability, seasonality, distribution and consumer demand. Microbiological safety is critical in confectionery products. Raw nuts may contain pathogens; products must therefore be processed and stored to prevent this. Milk may contain *listeria,* making it critical to avoid moisture and condensation. A raw-material and finished-product testing program needs to be in place to monitor your environment and products going out the door. A hold/release program will prevent any products from getting out of your control.

FORMULATIONS

The formulation chosen for a confection can directly impact how well the flavor and texture are maintained. Let's look at a few examples to see what impacts shelf life.

Eutetics/Softening of a Coating

- Eutetics could occur, decreasing shelf life and causing the product to bloom, with the possibility of fat deterioration when incompatible fats are blended together in a formula.
- Cocoa butter and palm kernel oil are not compatible and will cause softening and eutetics when mixed together, even in small quantities.
- A general rule of thumb is to not mix more than 4 percent of the fat with cocoa butter when manufacturing a compound coating.

Graining

- In a caramel, graining can occur if all the sugars are not dissolved before completion of the cooking cycle. At least 25 percent moisture in the caramel premix and heating to 160° to 180°F while agitating can aid in this process.
- A rule of thumb is to have more corn syrup solids than sucrose solids in caramel.

Moisture

- Moisture migration can occur when a drier inclusion comes in contact with a higher-moisture piece, causing the texture to become more hard.
- Keeping a meltaway smooth upon storage may require actual tempering of the chocolate with the added fat before going further in the process.

Fat Migration

- Everything likes to come to equilibrium — a balanced state or unchanging system.
- Center fats will rise to the surface, softening chocolate and hardening the center.
- Consult your specialty fat supplier to formulate the correct fat for your recipe.
- Milk fat is often added to dark chocolate to provide protection against bloom, delaying the transformation from form V to form VI (the highest melting polymorphic form).

Oxidative Rancidity

- Oxidative rancidity can occur relatively rapidly when high-fat centers or roasted nuts are used in a formulation.
- Centers may not be completely coated when using nuts, exposing the chocolate and nuts to the possibility of bloom.
- Stale or cardboardy flavor can also occur.

MANUFACTURING

Whether confections are manufactured by hand or using factory equipment, conditions must be maintained to maximize shelf life. For moulded pieces, one must use properly tempered chocolate in room-temperature moulds that pass through a cooling tunnel to set the product for shrinkage and easy demoulding. Good mould design and ➤

consistent moulding procedures will minimize potential problems.

During enrobing a center is passed through a curtain of chocolate or compound coating and then over a bottomer to coat the bases. Sometimes bases are coated with a compound coating first to aid in integrity or to prevent fat migration, and then enrobed with chocolate. Pieces can also be double enrobed to ensure extra coating if the center is vulnerable to softening or leakage, or difficult to coat. If enrobed centers are cooled too rapidly, the chocolate could crack; if cooled too slowly, it could end up discolored and soft. The big issue is that this problem may not be apparent right away and could emerge later in the distribution process or when your customer purchases the product.

Solid Chocolate

Temper

- Improperly tempered chocolate will continue to stabilize after the product is wrapped and has left the factory, which may lead to soft texture and the appearance of fat crystals or bloom.
- Lack of contraction (shrinkage) in a mould for product releases can be due to improper tempering.
- Dull appearances, poor snap and long set times can be from improper tempering.

Moulding

- Improperly designed moulds can lead to poor-quality products.
- Warm moulds can delay onset of crystallization.
- Cold moulds can expose chocolate to premature cooling, forming incorrect crystals.

Enrobing

- If centers are too warm, they can detemper the chocolate.
- If a piece has an uneven surface to coat, this could cause the center to be exposed, creating conditions for reduced shelf life.
- Incorrect viscosity may also alter coverage rate as well as increase feet formed at the base of each piece.

Cooling

- Chocolate and compound require different cooling tunnel conditions.

  –Chocolate needs to be cooled gently with moderate air flow (55° to 60°F).

  –Compound coatings are best cooled in colder tunnels (40° to 45°F) because they spontaneously solidify in a stable crystal form.
- All tunnels should warm to nearly room temperature at exiting to prevent condensation.

Confections do not like temperature variation and prefer constant temperature and humidity during storage.

PACKAGING AND STORAGE ISSUES

Packaging types will have a great influence on the stability of the confectionery product over time. The goal is to keep flavor and texture in and moisture or off-flavors out. Moisture can cause cracking of, for example, pretzels coated with chocolate and could make them soggy. Milk chocolate is more susceptible to flavor degradation if packaging is not controlled. There are many types of packaging materials such as polypropylene, metalized or multilayered films. Packaging suppliers are excellent resources for the best type of packaging for a specific product.

Following are some things to take into consideration:

- Heat sealing — be careful if shrink filming is used; this could cause bloom due to excessive heat.
- High-moisture pieces may lose and trap moisture. This could cause molding if tight packaging is being used. Sometimes wax paper is the best option due to its semi-permeability.
- Packaging material could cause off- ➤

White chocolate is especially susceptible to light-induced degradation of flavor due to its lack of natural antioxidants. Exposed nut pieces would also be susceptible to light-induced rancidity.

odors and off-flavors from inks used, the type of material in the packaging and from where the packaging has been stored.

- The Robinson test can be used to evaluate if packaging materials are a source of off-flavors. Place a folded piece of the packaging material (20 cm × 22 cm) along with 15 grams of grated chocolate in a sealed jar. Place the jar in the dark at room temperature (20°C/68°F) at 75 percent RH (if needed, add saturated salts to create a high humidity) for 48 hours. The flavor can then be evaluated as compared to a standard, and specific requirements can be developed as to how much flavor pickup is acceptable for the specific product. This would be approximately equivalent to nine months of shelf life.

Storage of confections is critical to maintaining the original flavor and texture when the piece is fresh. Confections do not like temperature variation and prefer constant temperature and humidity during storage, distribution and getting the product to the store shelves. It can be difficult to control what happens.

Ideal storage conditions would be in a cool, dry environment, away from off-odors, at 55° to 70°F at 60 percent relative humidity — some say as high as 70 percent. *Note:* relative humidity is the amount of moisture in the air that could then be absorbed by the product.

Points to Consider:

- During the fat phase of a confection, it is partially solidified. At this point it will either continue to solidify or remain liquid depending on how the product is stored.
- If products are stored at too low of a temperature, condensation can form and create sugar bloom when coming back to room temperature.
- Be careful when freezing candies to preserve freshness and halt center oil migration. Care must be taken with delicate shells so they do not crack during the rewarming process. This must be carefully controlled to prevent condensation from forming on the products.
- Compound coatings would be more heat resistant than chocolates mainly due to higher melting points with some compound coatings and the fact that they do not require tempering.

DISTRIBUTION

All of the hard work of maintaining the product to this point would be for nothing if the product is not transported and distributed in conditions similar to how it is stored. Refrigerated trucks, controlling the product on docks and storage in the distribution centers will all influence how well the product will hold up until it reaches consumers.

What Needs to Occur?

- During warm months, refrigerated sealed or locked containers would be required.
- Distribution systems must handle confectionery products correctly.
- Light in display cases can influence the quality of a confection — white chocolate is especially susceptible to light-induced degradation of flavor due to its lack of natural antioxidants. Exposed nut pieces would also be susceptible to light-induced rancidity.
- Infestation can also occur during transporting and distribution. Examining transporting vehicles and keeping the temperature controlled greatly helps eliminate this concern. Sealed packages can deter insects from trying to penetrate through folds or bore through packaging. ➤

Shelf-life Recommendations

Category of Product	Temperate Conditions	Tropical Conditions
Milk Chocolate	16 months	12 months
Dark Chocolate	24 months	24 months
White Chocolate	16 months	12 months
Fondant-cream-filled Chocolates	18 months	12 months
Chocolate with Nuts, etc.	12 months	9 months
Wafer/Cereal-centered Product	12 months	9 months

Figure 1

Not everyone has the resources to perform stability or shelf-life testing, but we all have the ability to perform sensory analysis on our products to look for degradation and loss of product integrity.

DETERMINATION OF SHELF LIFE

Most packaging technologists, recommend the following for shelf life of confections: temperate conditions would be controlled and tropical conditions would adjust to the likelihood of adverse situations such as unrefrigerated transport/storage or ship conditions.

Figure 1 shows the longest life recommendations for products sealed and stored properly away from light for the purpose of *Best Before* date. This knowledge can be used as a guide for new products. Conditioned cabinets at specific temperatures and relative humidity for a specific time can also be used to predict accelerated shelf life. An example follows.

Bloom Stability Potential of a Product – A Tool to Aid in Shelf-life Determination

- General reference — one week of cycling is equal to one month of shelf life.
- Hold samples at 30°C (84°F) for approximately 12 hours.
- Hold samples at 20°C (68°F) for approximately 12 hours.
- Continue until bloom is observed.
- If a sample holds its integrity for 12 weeks, the product can be predicted to maintain its integrity for 12 months.

REMEDIES

- Understand the fat systems of your products — cocoa butter and vegetable fats are not compatible.
- The addition of milk fat can aid in bloom resistance.
- Compound coatings can be used to increase heat resistance.
- Minimize migration by designing resistance into the product.

Many factors contribute to loss of shelf life and failure of a customer to return to purchase a product. Not everyone has the resources to perform stability or shelf-life testing, but we all have the ability to perform sensory analysis on our products to look for degradation and loss of product integrity. □

REFERENCES

Beckett, S.T. *Industrial Chocolate Manufacture and Use*, 3rd edition.

Fontana, A. Water Activity for Predicting Quality and Shelf Life. *MC*, November, 2005

Man, D., A. Jones. *Shelf Life Evaluation of Foods,* 2nd edition.

Minifie, B.N. *Chocolate, Cocoa, and Confectionery*, 3rd edition.

Seguine, E.S. Factors Influencing the Taste, Selection and Specification of Chocolate, *PMCA Proceedings*, 1998.

Subramaniam, P. Accelerated Shelf Life Testing. *MC,* June, 1998.

Weyland, M. Shelf Life of Chocolate and Compound Coatings. *MC,* September, 1998.

Presented at the AACT Annual Technical Seminar