AMERICAN JOURNAL OF PHARMTECH RESEARCH

Journal home page: http://www.ajptr.com/

A Review on Hard Candy Formulation Key Ingredient and Solution for Candy Processing Problems

Parepalli Srikanth[1]*, Madhusudan Rao. Y[2], Shravan Kumar Y[3]

1. Department of Pharmaceutics, Vaagdevi College of Pharmacy, Warangal, India

2. Director of Vaagdevi colleges of pharmacy, Warangal, India

3. Faculty Department of Pharmaceutics, Vaagdevi College of Pharmacy, Warangal.

ABSTRACT

Hard candies are experiencing a renewed popularity as a means of delivering many different drug products. They are used for patients who cannot swallow solid oral dosage forms as well as for medications designed to be released slowly to yield a constant level of drug in the oral cavity or to bathe the throat tissues in a solution of the drug. Knowledge on the formulation parameters as well as the process of cooking parameters such as concentration of corn syrup as well as type of corn syrup, temperature of cooking, moisture content type of cooking vessel helpful in solving the problems, Elegance is out most important parameter for candies as this parameter helps in improving patient compliance. So elegance of the candy can be increased by optimizing the formulation as well as process parameters which in turn helpful in enhancing the stability of the dosage form.

Keywords: Corn syrup, Elegance, Stability, Patient Compliance.

*Corresponding Author Email: psr4172@gmail.com

Received 27 July 2014, Accepted 13 August2014

Please cite this article as: Parepalli S *et al*., A Review on Hard Candy Formulation Key Ingredient and Solution for Candy Processing Problems. American Journal of PharmTech Research 2015.

INTRODUCTION

Invention of new chemical moiety is a tedious, costly and it is a time taking task. Keeping this moiety into a better dosage form which in turn helpful in supporting the efficacy of drug. Efficacy is most key factor which helps in the commercialization of the product. Along with the efficacy patient convince also plays a vital role in increasing the essence of the dosage form. One of the dosage form that fulfilling the essence or convince of the patients is the lozenges. In terms of cost as well as ease of taking dosage forms. So knowledge of lozenges and making of lozenges, as well as problems that encounter during processing of lozenges is necessary to make the dosage form more effective. The word "Lozenge" is derived from French word "Losenge" which means a diamond shaped geometry having four equal sides. Lozenges and pastilles have been developed since 20th century in pharmacy and is still under commercial production[1]. Essentially, the preparation of hard candy lozenges can be considered an art[2]. Many of the formulations used in confectionary manufacturing, and the rationale used for solving problem areas, are based on experience and intuition rather than scientific deduction. The confectionary equipment utilized by the manufacturer of lozenges is suitable for the preparation of candies but is not designed to produce a controlled and reproducible medicated candy with close tolerances as to size. Weight and quantity of drug concentration per unit dose the formulator must gain a comprehensive knowledge of the physical and chemical qualities of raw materials in the product and become familiar with all aspects of candy base production in order to prepare a medicated product that conforms to the specifications for good manufacturing procedures. A review of possible shelf life problems must be determined through stability testing after the product is manufactured. The formulator in essence, is required to bring a scientific approach to an empirical art.

Hard Candy Lozenges

Hard candy lozenges are mixtures of sugar and other carbohydrates in an amorphous (non-crystalline) or glassy state. They can also be regarded as solid syrups of sugars. The moisture content and weight of hard candy lozenge should be between, 0.5 to 1.5%, 1.5-4.5g, formulated with 50-60% of sucrose and 40-50% of liquid glucose respectively[2,3,4,5]. These should undergo a slow and uniform dissolution or erosion over 5-10min., and should not disintegrate. The temperature requirements for their preparation is usually high hence heat labile materials cannot be incorporated in them.[3, 4]

In the formulation of hard candy lozenges key ingredient is the corn syrup.

Corn Syrup

Prorduction

Corn syrups are produced by either acid, enzyme[3] acid-enzyme combination hydrolysis of cornstarch and are generally available in several grades, varying in degree of conversion [dextrose equivalent (DE)] and solids content (degrees Baume)

Manufacture[3,6]

The manufacture of all corn sweeteners begins with the hydrolysis of cornstarch, a process involving the splitting of the starch molecules by Chemical reaction with water. A variety of acids will affect the conversion, The manufacturing time and temperature are varied depending on the type of corn sweetener to be manufactured. As the reaction progresses, the gelatinized starch is converted first to other polysaccharides and subsequently to sugars, mostly maltose and dextrose. The sugar content increases and viscosity decreases as the conversion proceeds. Complete hydrolysis produces dextrose. The hydrolysis of the starch is halted when partially complete-to produce corn syrup, the exact degree depending on the type of syrup being made. Partial hydrolysis of starch converts part of the starch completely to dextrose[1] he remainder, which is not completely hydrolyzed to dextrose, consists of maltose and higher saccharides. The proportions of saccharides vary, depending on the extent and method of hydrolysis.

Dextrose Equivalent [3, 6]

Dextrose equivalent is a measure of the reducing-sugar content of a product calculated as dextrose and expressed as a percentage of the total dry substance[1]. Essentially, the dextrose equivalent is the percentage of pure dextrose that gives the same analytical effect as is given by the corn syrup. Certain sugars, such as dextrose, maltose, lactose, and levulose, are called reducing sugars. Sucrose is not a reducing sugar. Generally, dextrose equivalent indicates the degree of conversion in corn syrup. The higher the dextrose equivalent, the further the conversion has been carried out, resulting in less of the higher sugars (maltotriose and maltotetrose). The classes of corn syrups categorized as to degree of conversion

Table.1: A typical analysis of corn syrup with representative Carbohydrate composition [3, 6]

Classes of Corn Syrups	Degree of Conversion
Low-conversion corn syrup	20-38 DE
Regular conversion corn syrup	38-48 DE
Intermediate-conversion corn syrup	48-58 DE
High-conversion corn syrup	58-68 DE
Extra high-conversion corn syrup	68-99 DE

Dextrose	100 DE

For caramels, low dextrose-equivalent syrup is preferred because it prevents the product from "flowing" in the cold state because of the high viscosity that low-dextrose-equivalent corn syrups impart to products to which they are added[7]. The high viscosity prevents the caramel from losing its shape when the product is stored at elevated temperature or high-humidity conditions. High-dextrose-equivalent corn syrups are generally used for filling where a low-viscosity and higher sweetness medium is required.

The properties and functional applications of corn syrups based on degree of conversion

Browning reaction[3]

The typical brown color that candy base may develop during cooking results from a reaction between reducing sugars and proteins as the corn syrup conversion continues. More reducing sugars are produced. The higher dextrose equivalent syrups are more prone to darkening.

Fermentability

Fermentable sugars increase with dextrose equivalent level, the high-DE; dextrose-rich corn syrups are always utilized in making yeast-raised products with crystalline dextrose as the ultimate ingredient.

Foam stabilizer

Because the lower dextrose equivalent syrups have a greater ability to retain incorporated air, so there is requirement of addition of foam stabilizers or antifoaming agents during cooking.

Hygroscopicity[3, 8]

The more highly converted syrups have the greatest ability to take up water and the low-conversion products the least.

Invert Sugar

Invert sugar is a mixture of levulose and dextrose in equal parts, produced by inverting sucrose. Invert sugar has the power to absorb moisture from the air and at the same time retard crystallization.

Applications [3,6]

Candy confectionery and sweet making

- Major ingredient of hard boiled candies.
- Conjunction with sugar for flavoured candies manufacture.
- Extensively popular in sweet manufacturing business as it prevents crystallization and used to the level of 30% - 40%. Being non-crystalline it produces homogeneous confectionery.

Pharmaceuticals

For cough syrups and vitamin based tonics, So_2 free liquid glucose is used to provide mild sweetness and body consistency. It makes principal ingredient for cough lozenges and acts as granulating agent for tablet coating.

Flavouring

- Flavouring and moistening agent in chewing tobacco.
- Flavouring and preservative in mouth freshening formulation.
- Improves the keeping quality of tobacco.
- Substitute for Honey
- To supply solids at a reduced cost
- To adjust sweetness level.

Control of sugar crystallization is a primary application of corn syrup in hard candy making.

Mechanism of Inhibition of Crystallization[3,8]

Since sugar is readily crystallized when the water of sugar solutions is boiled off the presence of the noncrystallizable corn syrup is necessary to inhibit the graining or re crystallization of the sucrose. This inhibition of sugar recrystallization is accomplished by surrounding each molecule of sucrose with a film of uncrystallizable corn syrup.

Hardcandy

Hard candy is the unique among confections[.5] the finished product has the lowest moisture content of all candies, about 1-3%. It has a lowest ERH about 25 to 35 %, depending up on its sugar s composition and moisture content. Consequently, it is the most susceptible to humidity damage and it has to packaged accordingly. The texture of hard candy is often referred to as a glass, because a good hard candy should have no sugar crystals present. It could actually be called as solid syrup. The starting ingredients of hard are simple. For instance, sugar, corn syrup, water and flavor are the ingredients of a hard candy. The possibilities of variation are end less. Many other ingredients can be mixed into the candy, or folded in, or pumped into the center of the candy. The treatment given to the candy by the candy makers can alter the finished product in many ways. Hard candy receives the severest heat treatment compared to other candies, because it is cooked to 290-300^{0}F in open fire cooking. A complete line of hard candy processing equipments is specifically suited to the product. Included in this line are vacuum cookers, batch kneaders, pulling machines, heated batch holders, heated rope sizer and various plastic forming and cutting machines. One of enemies of a good hard candy is inversion, the splitting of the sucrose molecules

into dextrose and lavulose, which is invert sugar. This often causes poor shelf life, stickiness and graining in candy. Cooking too slowly, cooking to too high a temperature, delays in processing cooked candy, or the presence of an acid in the cooking mixture may cause these problems. The other enemy of hard candy is humidity, which causes it to become sticky, then dull and gummy. This is commonly called moisture graining. Some resistance to moisture graining can be formulated into the hard candy by the ingredients used and their ratio. Regular 42 DE corn syrup gives good resistance [4,1] but the more viscous product makes processing more difficult. High maltose corn syrup produce a candy with very good moisture resistance and light color through the heating process, but the finished candy tends to be more fragile. The lower the moisture content in hard candy the moisture content in hard candy the more humidity resistant it is. Candy with a moisture content of 2% or less is considerably more resistant than a candy with four percent moisture. The later would have a poor shelf life. Ron Lees attribute the lower graining resistance of high moisture content candy to a function of viscosity. Since hard candy is really a high viscosity. Super- cooled syrup, a product with high moisture content will be less viscous. Sucrose molecules in a less viscous matrix can more readily migrate and forms crystals is what we observe as graining. Science there is a high initial percentage of moisture present in the candy, very little added moisture is needed from the atmosphere to make graining take place more rapidly. The preceding topics are some of the areas where hard candy differ from other candies. However, there is seldom well defined difference in the characteristics of various confections

Hard Candy Graining, Causes and Prevention

By far most common problem encountered in hard candy during production and storage is graining. Candy grains during storage changes from clear to opaque in appearance and tends to lose flavor. Graining during storage usually accompanied by sticyness and progresses from the surface towards center occasionally, graining will occur throughout the candy equally and candy will remain dry. When hard candy batch grains during production it loses its plastic consistency and becomes short in texture, its appearance also changes from clear to opaque. Once grained the batch can no longer be processed and must be scrapped. In order to solve graining problems in hard candy it is first necessary to grain a through understanding of its causes and the control mechanism available.

Controlling Ingredients of Graining [9,4]

Hard candy is basically a super cooled. Solution of sucrose and other sugars and is, therefore, in an amorphous or glossy state. Graining occurs when sucrose comes out of solution and forms crystal or grains of sugar. Sucrose crystallizes very readily; it is very difficult to process a hard candy

based on sucrose alone, therefore , other sugars which control crystallization in candy are often referred as doctor. Corn syrup are by far the most commonly used doctors in hard candy. Most hard candy is made from 42DE, acid converted corn syrup. High maltose corn syrup offer some advantages and are gaining popularity especially in Europe. Invert sugar is also occasionally used either alone or in combination with corn syrup. Invert sugar is an equimolar mixture of fructose and glucose produced by the hydrolysis of sucrose. Some invert sugar is formed during the cooking of hard candy this is referred to as process inversion.

Control Mechanisms: There are three main mechanisms by which crystallization can be controlled.[4]

Other molecular species: Include other molecular spices with the sucrose in the formula. The other simple sugar in corn syrup, invert sugar prevents or retards the formation of sucrose crystals.

Maintain High Viscosity: The more viscous the candy is the more difficult it is for the sucrose molecules to order themselves and form crystals. Viscosity in a hard candy formula is provided by the high molecular weight sugar in the corn syrup, the low moisture content of the system and low temperature processing.(viscosity increases as the cooked batch cools.)

Minimize Mixing: Minimize mixing and turbulence in the cooked candy batch. Crystallization can be induced by excessive mixing after cooking. We use this property in the production of fondant and should avoid it in hard candy.

Causes for Graining

Bearing in mind the above mechanisms we can explain some of the more common causes of graining.

1) Insufficient corn syrup in the formula. A wide range of corn syrup contents can be found in candy formulae 20 to 70[1,4,5,8] percent however, the vast majority are with in the range of 35- 40 percent of corn syrup on a dry basis. The ratio is variable and depends upon the type of equipment and the recipe, This difference in the concentration of corn syrup to attain the smoothness and transparency may be due type of apparatus used in the cooking process as follows.[4]

Table.2: Concentration of Corn Syrupy used for different Type of equipment[3,8]

Type of equipment	Concentration of Corn Syrup
Open kettle	20%
Batch vacuum cookers	30 %
Semi-continuous cookers	35 %
Continuous-cookers	40%

The difference in the above requirements is due to the increasing amounts of mechanical action or turbulence to which the candy is subjected after cooking. Higher corn syrup content are required to

prevent graining when more agitation is involved. Higher levels of corn syrup can be used in any of the above processes. As corn syrup less expensive than sugar there is a considerable incentive to maximize its use .The negative aspects of higher corn syrup ratios are reduced flavour release, reduced crispiness and increased humectancy. Once the desired formula has been established it is essential to ensure that it is consistently maintained during production. The most widely used quality control check is a reducing sugar measurement by fehiling titration. This analysis measures the quality of reducing sugars in the formula. This is basically the same as the DE measurement used in the specification of corn syrup. The anticipated RS of a formula must be known prior to interpreting the result of an analysis. The theoretical RS can be established by converting the recipe to dry weight and calculating the total RS[3]

2) High moisture content in cooked candy. The lower the moisture content the higher the viscosity of the hard candy will be and consequently the more resistant to graining. Ideally the moisture content should be around 1 percent and should not exceed 3 percent.

3) Excessive mixing at high temperature. During cooking, the syrup becomes progressively concentrated but the increasing temperatures. During cooking, the syrup becomes progressively concentrated but the increasing temperatures maintain it at saturation point. Once cooking is completed and the temperature begins to, fall the syrup becomes super- saturation and subjected to graining if excessively mixed while at a high temperature and, consequently, low viscosity This is the reason that continuous cooking system require higher corn syrup ratios; the cooked candy is extracted from vaccum chamber and colors, flavors and acids are mixed into the mass at high temperatures while the fluidity is still low.

4) Prolonged holding on hot tables prior to processing. Batches of hard candy are often held on stem-heated tables while waiting further processing; excessive holding time can lead to graining. Higher corn syrup ratios allow longer holding times.

5) Addition of grained rework to cooked batches. It is standard practices to add rework to hard candy batches at the time of flavor and color addition. It is very important to ensure that no grained candy rework will seed the batch as crystals of sugar act as nuclei which will induce thought the mass.

6) Processing storage in high humidity areas. Hard candy has equilibrium relative humidity is above 28 percent. This means that it will pick up the moisture from the atmosphere whenever the relative humidity is above 28 percent. The rate at which moisture is gained will increase. When hard candy picks up moisture it becomes sticky as a layer of its surface dissolve to form a syrup. The low viscosity of this syrup allows sugar to crystallize resulting in a grained surface. Graining

then slowly progress inwards until the whole candy eventually grained. This process often initiated in the plant when hard candy is held for prolonged periods prior to wrapping. As the relative humidity in the plat is rarely 28 percent, hard candy should be wrapped as soon as possible after forming, ideally while slightly above the ambient temperature of the packing room. If immediate wrapping and packing is not possible a low humidity holding room should be provided. Wrapping and packing materials for hard candy should be selected to provide the best possible moisture barrier properties in order to protect the product during storage.

7) Storage at high temperatures. Elevate storage temperatures can cause hard candy to grain, due to softening. In this case the crystallization takes place evenly throughout the candy rather than from the surface inward. Storage at temperatures above 100^0F should be avoided. By careful attention to the formula, process packing materials and storage conditions, graining in hard candy can be prevented and a shelf life can be prevented and a shelf life can be prevented and a shelf life of at least one year is obtained.

Hard Candy Processing Problems and Solution[3,6,8]

Good appearance and good eating quality are two important goals hard candy manufacturing.

Problems Releated to Apperance

Shape, Gloss, Color, Cracking, Striping, Leakers, Dustiness, Damage and Graining

Shape

The mould cavity should be provided with accurate quantity of material to be filled with thus produce a well formed piece. If the candy rope is too large, the piece is over sized. These are usually formed at the end of batch when the final piece of rope enters the die without being streched and sized down. If the rope is too small, or if the batch is too cool or hard, incomplete or poorly formed pieces are produced. Candy that is over pulled will puff of and distort after release of the pressure of forming dies. Unpulled candy which contains a higher percentage of fats is elastic and will distort after forming. Chip, pillow, or straw cutting machines must also provide with a rope of proper size to get a uniform sized candy. The chains and knifes of these cutters must be well maintained and adjusted to produce quality candies. When the temperature of candy is too high, the candy will be soft. As it is formed and discharged on to the cooling conveyer, it will deform on the wire belt and the wire loops will cause indentations on the candy surface.

Gloss

All hard candy should be shiny or have a gloss, especially the pulled candies. Initially, the sugar and corn syrup mixture must be cooked to a sufficiently high temperature and subjected to

sufficient vacuum to obtain good moisture removal. Candy containing excess of moisture will not develop and maintain the characteristic stain sheen of pulled hard candy.

- When making pulled candy, the batches must be: cooled sufficiently before pulling.
- Pulled sufficiently but not over pulled.
- Processed on equipment which has contact parts warmed to the candy temperature. If the parts are too cold surface cracking takes place. If too hot, the gloss will suffer.
- Cooled rapidly after forming.
- Protected from humidity after cooling

There are several precautions to observe in producing a high gloss candy.

1) To obtain best sheen, the sugar mass coming from the cooker must be cooked with low moisture content.
2) The batch must be cooled sufficiently to 200 to 210 ^{0}F
3) The gloss will be reduced if the contact parts of the batch roller, sizer or forming machine are too hot, over 190 ^{0}F
4) Rapid even cooling after forming is essential to maintain a high gloss.
5) Candies must well protected from moisture.

There is a beneficial procedure used in hand making candy called **putting on a shine** or the application of clear coating on the candy. This is done with the clear hot material obtained with out addition of flavour, drug and color. These coating is done to the formed candy. The only disadvantage of these shine or gloss surface coating is in the momentary lack of flavor until the thin layer of unflavored candy is dissolved in the mouth.

Color

Candy colors should be bright and appetizing. The color should also be characteristic of the flavour used. The consumer tends to select candy flavors based up on the candy color. The cooked hard candy base should be light in color to obtain good color in the finished lozenge. If considerable discoloration of the sugar has taken place, the lozenge color will have a brownish cast. There are several causes for darkening of the cooked sugar mixture.

- Cooking at a high temperature and low vacuum.
- Delaying in the processing of the hot candy in the batch process.
- Using some lots of corn syrup which do not withstand the heating process as well as others.
- Recycling rework syrup which is too dark in color.

When adding colors, insure consistency by;

1) Uniform strength colors.
2) Accurate measurement of colors.
3) Prevention of processing delays.

Cracking

It is important that contact parts of holding and forming equipments have heaters and that their temperature be close to that of the candy. If the surface temperature is too low, the candy surface is cooled, losing its pliability. When the candy is stretched and formed, the surface cracks. If the surface temperatures of the contact parts are too high, satin finish candies and there is a danger of candy sticking to the contact parts.

Striping

Although good workmanship or the lack of it is evident in all phases, the workmanship used in making hard candy is most obvious in the striped candies Should be even in size and placement. They should be well defined and should not smear, blur, or blend into candy. Colored striping candy should have the same temperature and moisture content of the candy batch on which is applied. If the stripe is too cool or too low in moisture, it will crack in the forming operation. If a batch of stripe is made ahead for several batches and kept heated too long, some inversion can take place. This causes a more sticky stripes and smearing can take place in forming.

Leakers

In the formation of filled hard candy, the batch of candy around the filling pipes must be pliable, evenly tempered, and at the correct temperature. If the forming dies will not seal the cut ends of the rope together. There will be small holes which will allow some of the hot filling to ooze out. The filling can get on the surfaces of the candied, causing stickiness and unsightliness. This problem is accentuated in making a filled pulled candy if the candy is pulled candy if the candy is pulled too much and becomes somewhat spongy.

Dustiness

This is problem mostly in unwrapped hard candies but it also occurs in twist wrapped candies. It is usually only a problem during very cold weather when the in door relative humidity is extremely low, about 15-20% 0r less. When packing unwrapped hard candies in bags, tins, or glass containers, it is necessary to pass the candies in over screen to remove chips and dust. At all stages, the candy should be moved gently to minimize abrasion and breakage. During periods of very low humidity dustiness shows up on the surface of dark colored wrapped candies. This is due to the abrasion of the candy on the transfer discs of the twist wrapping machines. The problem usually disappears after the candy has been held a while at a higher humidity atmosphere. The dust absorbs

some moisture, loss its whiteness and is not visible. One solution to the problem of dustiness is to have some humidifying equipments in the operation in the wrapping department during extremely cold, low humidity weather.

Damage

Damaged hard candy is that which is broken or chipped. Pulled candies are more brittle and break easily. Shapes with sharp corners have tendency to break. In the handling of the candy, from manufacturing through shipment, care must be taken in its movement. Hard candy is essentially a glass and must be treated accordingly. At any place in the process where candy drops, the distance must be minimized and the impact surface must be padded. The impact of candy against candy should also be minimized. Even after candy is packaged, it must be handled and shipped with care. This is especially true of tins, bags and jars of unwrapped candies.

Graining[3,4,6]

Once hard candy is made and cooled to room temperature, it begins to absorb moisture if the air surrounding it is above the ERH of the candy. This is usually 25-30% relative humidity. In time, the surface of the candy softens and becomes dull in appearance. The process usually stops here. In extreme cases, the graining can work its way through the candy with are resulting coarse gummy fondant type of texture. Hard candy must be protected by moisture or storage in air tight containers. Pulled candies and acidified candies are more suspsectable to moisture graining than clear sweet candies. The application of clear shine during production is of some help in retarding the graining process. Candies containing a center filling which has a moisture content of sixteen percent or more will grain outward from the center. This is retarded by the use low moisture filling. There should be no problem with internal graining when using fat based filling containg no moisture.

Problems Releated to Eating Quality

The consuming of the finished candy by the customer is the final quality test of any candy. If it is an enjoyable experience, there will be repeat sales. Several factors in the eating evaluation of hard candy are: Flavor, Acidulation, Texture, Freshness and purity.

Flavor

The flavor of a hard candy should be a true facsimile of the desired flavor. It should be neither too strong nor too weak, and the level should be consistent. Measurements must be accurate, and batch size must be uniform. Oil base flavors that tolerate high temperature are most desirable. In the case of continuous automated plant, metering systems can be calibrated regularly and usage compared against the system output.

Acidulation

The acidity level of an acidulated candy should be pleasant to the taste and can vary considerably depending up on the final desired results. The amount can range from 2.5% 0f citric acid in fruit sour to 5% used as background in a milder flavored candy. Here also, measurement and batch size are important. Various food acids are used to achieve different result. Some of them are citric, lactic, malic, fumaric and acetic acids.

Texture

Both clear and pulled hard candies should be smooth and free from roughness and sandiness. It is necessary to use correct levels of corn syrup to prevent sucrose crystal formation in the handling and pulling operations. These operations must also be carried out with the candy at sufficiently high temperature. Honey combed candies should be tender and free from large hard sections. The honeycombing operation must be done carefully. With removal of the butt ends which contains insufficient filling. Air pockets or bubbles are undesirable. The working and folding of batches must be kept at a minimum to avoid incoration of air.

Freshness

Fresh ingredients fats, flavor oils, etc should be used. Antioxidants are valuable in preserving freshness but cannot reverse oxidation once it has begun. If an ingredient is stale or rancid when added to the candy, it will remain that way. Naturally flavor oils should be purchased in amounts that would be used in short time. Storage in containers, and refrigeration increases the self life of flavor oils develops turpentine like flavor and odor when deterioration takes place.

Purity

Incorporation of undesirable materials into the candy during the course of manufacturing must be avoided. Employee should be instructed in proper hygiene and prevention of contamination. A foreign material is not always what might be expected. Take, for instance, this example: A mixing and heating kettle has been used to make a nut filling. The kettle is cleaned carefully and particles of nuts remain between and behind the scrapers on the sweep agitator. A chocolate filling is prepared in the same kettle. The nut particles work free and there is a foreign material in the chocolate filling. It is not a dangerous contaminant with cause for regulatory action but it is undesirable in the production of a high quality candy. It is necessary that processing equipment be well maintained so that machine are not shedding parts or grinding metal into the candy. Metal detectors are valuable, but prevention is essential. Many foreign materials can enter the candy in numerous ways Supervisory processing, quality control and management personnel needs to be constantly alert to possible problems and correct them as soon as observed. In conclusion, the

enjoyment of the appearance and taste of hard candy is its main purpose. It takes constant diligence and attention to detail to insure that hard candy meets these goals. In all candy cooking systems, a steady source of steam at uniform pressure is essential. Extreme fluctuation in steam pressure can cause problem and affect the over all quality of finished candy. All thermometers and gauges must be checked periodically. Samples of the candy should be taken from each cooker at least daily and checked for moisture content and reducing sugar content. The conditions existing at the time of sampling must be recorded for reference should correction be needed. The condition recorded should include pump or cooker speed, steam pressure in the cooker, cooking temperature and vacuum reading. These all have a relationship with the finished product. The moisture content of the sugar mass produced by the vacuum cooker can be determined by vacuum over drying or karlfischer method. The pre-cooked sugar blend moisture can be determined by refractive index. Total reducing sugar content can be determined by Lane-Eynon method. In all testing the procedure must followed as set forth in official method of analysis of association official analytical chemist. Several problems may be encountered in hard candy formulation, pre-cooking and cooking. Some foaming in the vacuum cooking process is normal, but at time excessive foaming caused by impurities on sugar crystals is problem. Addition of vegetable oil or silicone foam inhibitor is helpful. If the liquid sugar is used foam inhibitors are added to the storage tank. Deformers can be added to pre-cooking by a drip feed or metering pump. Browning or discoloration is another problem some corn syrup is yellowish to amber when received and acceptance levels have to be set for their receipt. Some corn syrup, if high in proteins, does not withstand the cooking process well, causing a darker finished cooked mass. Cooking at high temperatures and low vacuum will form more color- formation and gives a less viscous mass than cooking at lower temperature and maximum attainable vacuum. Discoloration can also take place if there are excessive delays between cooking and forming.

CONCLUSION

One formulation or procedure cannot be prepared for use in every hard candy factory. Ingredients ratio, final moisture, type and condition of equipment and many other variables all have a bearing on how the candy is processed or manipulated. The personnel of each factory generally develop a procedure that works best for them and which gives the desired end product. Quality cannot be inspected into the product. Management must be committed to high quality ingredients, packaging materials, equipment, formulation, surroundings the final control is in the hands of the operator as quality comes from trained employees who take pride in their work.

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