**Paper No. : 11**
**Paper Title: Food Analysis and Quality Control**
**Module- 34: Quality control of confectionary products**

## 34.1 INTRODUCTION

The art of confectionery manufacture date back to over 3000 years as per Egyptian records. Traditionally honey, boiled and concentrated sugar cane juices have been used in confectioneries. In modern times, alternative sweeteners from sources like corn and starches constitute an integral part of confectionery manufacture.

Source : Google images

Owing to the huge variation in finished products as well as raw materials in food sector, Quality control has an extremely important role to play. Quality control aims at controlling variation to within a tolerable level by taking corrective actions. Statistical and non-statistical techniques are employed to measure, analyze and control variation in food products. Statistical process control, acceptance sampling and visual inspection are widely used in food and allied sectors.

Maintenance of quality and manufacture of a standard confectionery should involve a very close control of raw materials, instrumentation, and statistical analysis of finished product. Statistical evaluation with respect to finished product includes weight control, sensory evaluation and packaging tests. The quality standards are set by the quality control departments. Chemists may

undertake preliminary analysis through visual inspection. Visual inspection is usually combined with sampling. This gives an idea of variation, cleanliness, infestation etc. in the sample.

## 34.2 CONFECTIONERY PRODUCTS

Confectionery products cover a wide spectrum of products ranging from candies, chocolates, cakes, and other sweet foods

### 34.2.1 CLASSIFICATION

Confectioneries may be broadly classified as:

- Sugar confectionery-These are not covered with chocolate. Examples include hard candy, toffies, fudge, fondants, jellies, pastilles etc.
- Chocolate confectionery-these are usually sugar confectioneries covered with chocolate and include chocolate bars and blocks.
- Flour Confectionery-baked fancy cakes that are either ice or chocolate covered
- Traditional Indian sweetmeats

### 34.2.2 CONFECTIONERY INGREDIENTS

1. Flours
   High flour temperatures can adversely affect the product quality. Therefore proper control of temperature must be exercised during steps like milling and pneumatic handling.
2. Sugars, Glucose syrups and other Sweeteners.
   Sugar (sucrose, saccharose, fructose, dextrose) is the main ingredient of confectionery products. Sugars used for commercial purpose may be either of cane or beet origin. Sugars may be used in various forms including refined sugars, various grades of brown sugar, syrups and invert sugar and others. Sugar alcohols like sorbitol and mannitol and non nutritive sweeteners including saccharin, cyclamates, acesulfame K, aspartame etc. have also been used in confectionery manufacture. Sugar must be dry and should meet the relevant particle size requirements and color specifications.
3. Confectionery Fats
   Raw fat obtained from various sources is subjected to refining prior to use in food. Refining includes neutralization, bleaching and deodorization. Commercial edible oils are obtained from coconut, palm, peanut, soybean, rapeseed, cottonseed, sesame seed, sunflower, olive, corn etc. Properties of fats that are of importance are consistency, aeration, resistance to oxidation, melting temperature. Physical properties of the fats muct be within the acceptable range as per relevant regulation
4. Milk and milk products
   Milk and milk products provide the desirable flavor to the confectionery products. Lactose, butter, condensed milk, evaporated milk, milk powder, whey powders, liquid

milk are the various forms in which milk is generally used in confectionery. Other forms are malted milk and cultured milks

5. Egg albumen and other aerating agents
   All soluble proteins show aeration property .Apart from albumen other aeration agents that are used include casein, whey, soy protein, skimmed milk powder, and gelatin. Quality of egg products must be evaluated from both bacteriological and functional property viewpoints.
6. Gelatinizing agents, gums, waxes-agar-agar, alginates, carrageenan, gum Arabic etc.
7. Starches, soy flour , soy protein
   Natural starches: corn, wheat, potato, arrowroot, tapioca, modified starches
8. Fruits, preserved fruits, jams, dried fruits. Fruits should be wholesome, of uniform size and confirm to cleanliness standards.
9. Nuts-almonds, cashew nuts, coconut, brazil nuts, chest nuts

## 34.3 QUALITY CONTROL

Confectionery in India have an estimated market size at US$ 1127 million & is growing at the rate of 11.9 % per annum. (Source: Datamonitor Sept-2010 report).

As per ISO 9000:2000, quality has been defined as “The totality of features and characteristics of a product, process or service that bear on its ability to satisfy stated or implied needs”.

FAO defines Quality control as a planned system of activities whose purpose is to provide a quality product.

Quality control is also known as quality inspection and thus as suggestive of the name it involves checking for quality standards at various steps of manufacturing.

Quality control is carried out in the following three areas of operation:

(1) Raw ingredients.
(2) Process of manufacture.
(3) Inspection of finished product.

### 34.3.1 CONTROL OF RAW MATERIALS

Preliminary testing is done to determine acceptability of delivery. Acceptance or rejection of the consignment is generally decided by the analytical chemists. This includes visual inspection. Raw material that fails to meet the prescribed standards is rejected. Sampling should be a representative of the bulk. On getting due approval for further processing from the concerned personnel, the containers are opened in batch rooms or stores and weighed amounts are sent for production process.

#### 34.3.1.1 TYPE OF RAW MATERIAL

- If the source of supply and manufacture is known and reliable, a superficial examination is sufficient.
- All packages, drums or container should be marked appropriately to avoid confusion.- glucose syrups (degree of conversion), starches(crème depositing or thin boiling) an fats ( melting point)
- Essential oils, flavors, spices, nuts, dried fruits, egg albumen are checked for quality differently.
- Essential oils are subjected to flavor tests, refractive index, specific gravity, purity tests
- Spices are tested through flavor tests, microbiological tests, extraneous filth
- In case of Cocoa beans, "cut" test is performed to check if they are properly fermented
- Nuts and dried fruits are analyzed for flavor, foreign matter, moisture content
- Sugars when used in the form of syrups should be checked for parameters like pH, total solids and invert sugar contents, color, temperature

**34.3.1.2 THE SUPPLIER**

- More known is the supplier less is the degree of inspection that needs to be carried out.
- Issues like specifications, keeping periods, type of packing, methods of testing should be discussed with the supplier.
- The supplier should have a quality control system for the manufacture.

**34.3.1.3 RECIEPT AND PREPARATION FOR PRODUCTION**

- Sugar, glucose syrup, mixed syrups, fats are usually delivered in tank truck and rail tank cars. Production personnel are also responsible for quality control.
- A rapid inspection of a representative sample drawn from the tanker s advised at the arrival of the tanker
- Some physical tests like specific gravity or moisture are carried out at such stage.
- Sample may be tasted and examined visually for foreign matter.
- Detection of defective or material of unacceptable quality must be reported by the personnel handling the opening of containers.
- Proper testing of alternative raw materials should be done when introduced.
- When using a substitute material, its purity must be checked prior to incorporation into the production process. Initial visual inspection servers as a quick means of inspection

**34.3.2 PROCESS CONTROL**

- The process of manufacture can be either a batch type production processes or continuous type production lines.
- Batch processes are handled manually .Therefore quality greatly depends on the efficiency and reliability of the workers

- Larger the product quantity greater are the number of batches and thus more likely are the chances of inter batch variation.
- It is not practically possible to do sufficient checking of each batch. Usually one analytical testing is done for each batch like moisture content.
- Data to formulate continuous processes are obtained from automated bath processes.
- Time of cooking and cooling are longer in a batch processes compared to continuous processes.
- Type of process used depends on the type of end product:
    1. Fudge, caramel: Maillard reaction between the milk proteins and sugar components leads to desirable flavor and color generation. Short duration continuous processes require substitution of additional caramelizers to complete the process
    2. Pectin jellies: Appreciable sugar inversion is attainable in batch boiling. Sugar inversion is required to generate acidity which is a desirable in case of pectin jellies.
    3. Microbial contamination: ferments, molds and enzymes are present in raw materials like cocoa beans, nuts, dried fruits, egg albumen. These microbes are not inhibited in batch processes unlike when added towards the end of continuous process.

### 34.3.3 FINISHED PRODUCT INSPECTION

- Adoption of the in- line control eliminates the need for frequent inspection.
- Generally the finished product is analyzed for three significant parameters namely: Appearance, taste and weight.

#### 34.3.3.1 APPEARANCE

Appearance involves both the product appearance and the packaging. The finished product should have satisfactory appearance. A “pattern” consisting of the packed box of the product being manufactured is provided to the inspection staff. The pattern is approved by the marketing and quality control department.

#### 34.3.3.2 TASTE CHECKS

Samples taken for weight control are also subjected to sensory evaluation. Various sensory evaluation methods may be employed for this like the duo trio test, triangle test, hedonic scale rating etc.

Sensory tests are classified as follows:

(1) Discrimination

They have the objective of determining if differences exist between two or more products differences exist between two or more products. Type of questions that may be asked in discrimination sensory tests are “Is product A identical to product B?”, “ Is product A identical

to product B?", "Find the two similar products among the three samples provided.", " Find the odd sample among the three samples Find the odd sample among the three samples provided"

(2) Description

These have the objective of describing characteristics of a product and/or measuring any characteristics of a product and/or measuring any differences that are found between products .It answers questions like, "What does this product taste like? What does this product taste like?", "What are the three most important texture attributes you perceive in this product? ", "For which sensory attributes are the differences For which sensory attributes are the differences between product A and B most marked?

(4) Preference or Hedonics

These tests describe liking or acceptability of a product. Questions may be of the type "Do you like this product? ", "How much do you like this product on a scale of 1 to 10, where 1 = dislike product on a scale of 1 to 10, where 1 = dislike extremely, and 10 = like extremely? ", "Is product A better than product B?"

### 34.3.3.3 WEIGHT CONTROL

- Overweight pieces reduces profit
- Underweight products liable for legal offence
- Frequent checking is essential
- Weight charts are prepared
- A weight distribution chart helps to know the points where control is needed

### 34.3.3.4 FINISHED PACKS

Package testing is an important aspect of quality control since the keeping quality of finished product depends greatly on the quality of the packaging material. The following tests are recommended for package testing:

1. Flexible packaging- yield, dimensions, coefficient of friction, seal strength wherever applicable
2. Foil laminates-yield, sealing temperature
3. Waxed paper-yield, surface wax, total wax
4. Cartons, tins, etc-
5. Others-weight of a unit wrapping, goodness of print, odor and taint barrier property.

### 34.3.3.5 SHELF-LIFE STUDY

Rate of deterioration depends on combination of factors like temp of storage, ingredients quality, recipe used, nature of packaging. Shelf life refers to the time period for which the product retains its original quality at relevant storage conditions. Storage beyond this time period, the product becomes unsaleable. To determine the keeping life accelerated keeping tests are done In place of prolonged storage tests to save time.

- Prolonged storage tests-carried out under average shop conditions.
- Accelerated keeping tests involve subjecting the samples to different storage conditions along with different packaging. The samples are then tasted at appropriate intervals. Thermostatically controlled incubators at 18$^{o}$C, 23$^{o}$C, 27$^{o}$C, 29.5$^{o}$C are preferred. These are carried out for one to two months.

Special storage conditions:

Tropical conditions-29$^{o}$C, 85-90% RH
Cool storage-7$^{o}$c, 10$^{o}$C
Cold storage—7$^{o}$C

- Destructive testing:
  Sample is subjected to conditions of fluctuating temperatures. The maximum and minimum conditions used imitate the most severe tropical conditions.

**34.3.3.6 Microbial Testing**

Raw materials

Raw materials should be free from pathogens. This necessitates microbial testing of the raw materials on reception . The compulsory microbial standards for raw materials are *Salmonella*, negative, E/coli, negative, *enterobacteriaceae*, negative in 1g, total plate count-less than 5000, molds and yeasts-max 50 per gram, negative lypolytic activity in cocoa , egg albumen-negative.

Process Control

Risk of contamination is most associated with intermediate steps like soaking of gelatin .
Freshly prepared solutions must be used. Equipments used for such solutions must be washed and sterilized.

*Finished Products*

Proper control of raw material and processing minimizes risk of contamination in finished product.
Handling during packaging is a hazard

Complaints

Complaints from consumers must be addressed properly. Indications of microbial contamination are rancidity, off flavor generation, microbial liquefaction ets. Relevant samples must be analyzed for the root cause.

## 34.4 CHEMICAL ANALYSIS

1. Laboratory Practice
2. Sugar analysis
3. Moisture Analysis
4. Protein Analysis
5. Fat Analysis-Traditional method: Soxhlet apparatus. However accurate results can't be obtained by this method as some amount of bound fat remains unextracted and needs an additional step of acid hydrolysis. A modified and more rapid extraction system which is used now is the Fosslet fat analyzer. HCl is added following a reaction between perchloroethylene to facilitate acid hydrolysis. The extraction is completed by finally adding plaster of paris to absorb the aquous phase. This method gives very accurate results in the analysis of toffees and caramels.
6. Aflatoxins-Quantitative results are obtained by analyzing the sample for aflatoxins using HPLC with a fluorescence detector. Monoclonal antibodies based test kits have also been brought to use for detection of aflatoxins. Aflatoxins are preferentially absorbed onto minicolumns containing specific antibodies (e.g. Aflatest 10). Aflatoxins are eluted and absorbed onto fluorosil tips and quantified against standard in UV viewing cabinet.
7. Viscosity-U-tube, falling ball, cup or torsional viscometers have been used traditionally for viscosity measurement. However, digital rotational viscometer is the most widely used instrument for measuring viscosity. The instrument gives instant results on receiving temperature input. The results are expressed in poise.
8. Particle Size-Retention on standard sieves or by microscopy. Other methods are tedious and expensive
9. Acid Content-Volumetric method where the diluted sample is titrated against sodium hydroxide. Phenophthalein indicator is used to determine end point. Calculations are done using the relevant correction factor.

## 34.5 MORDERN METHODS

Some modern methods that can be employed for analysis of confectionery products:

1. Nuclear magnetic resonance (NMR)
   Hydrogen nuclei absorb radiofrequency energy in presence of magnetic field. NMR spectroscopy can be used to measure water content, fat content of dry products like chocolates. It also gives the solid: liquid ratio in products at varying temperature .This helps to predict the performance of fats.
2. Near Infrared(NIR)

NIR technique helps in very rapid determination of contents of fat, protein and moisture in the sample. This technique has disadvantage that for every analysis hundred different standards need to be calibrated.

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