

## A Current Perspective to Jam Production

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**Submitted:** 26 Apr 2021; **Accepted:** 03 May 2021; **Published:** 10 May 2021

**Citation:** Melaku Tafese Awulachew (2021) A Current Perspective to Jam Production. *Adv Nutr Food Sci* 6(1): 1-4.

### Abstract

The widespread and growing intake of fruit juice/jam products and their rich phytochemical profile suggest their important potential to affect the health of the populations. The aim of this paper is to review the technology and some of key technical factors that affecting jam production. The fresh fruits and vegetables have limited shelf life and it is necessary to process fresh fruits into different value-added products to increase its availability over an extended period and to stabilize the price during the glut season. The processed products have good potential for internal as well as external trade. The raw materials selected for jam manufacture should be fully ripe and free from defects such as mould and bruises. A perfect kind of jam honours and celebrates the goodness of fruits & value adds and minimizes the post-harvest losses. Jam is the product prepared from sound, ripe, fresh, dehydrated, frozen or previously packed fruits including fruit juices, fruit pulp, fruit juice concentrate or dry fruit by boiling its pieces or pulp or puree with nutritive sweeteners namely sugar, dextrose, invert sugar or liquid glucose to a suitable consistency. The amount of other ingredients (sugar, pectin and acid) is usually calculated according to availability of such ingredients in the basic raw material. Due to the differences in chemical composition of fruits and vegetables the amounts of other ingredients are usually calculated according to availability of such ingredients in the basic raw materials, therefore the analysis of the raw materials is pre-requisite for jam making. Generally, processing of fruits and vegetables offers immense scope for wastage minimization and value addition; thus, can generate significant income and employment in countries of agrarian economy and it is the most suitable method of preservation.

**Keywords:** Jam, Key-factors, Sugar, Pectin, Acid.

### Introduction

Jam usually is made from different fruits, vegetables or mixture of them which is considered as the basic ingredient; is one of the most effective means of preservation of fruits and vegetables [1]. Norman reported that Jam has defined in the United States as that semi-solid food made from not less than 45 parts by weight of the fruit ingredient to each 55parts by weight of sugar. This mixture is concentrated to 68 percent total soluble solids to achieve desired quality. Flavoring and coloring agents may be added. Jams generally have two types, the one which is developed from pulp of single fruit while the second type is prepared by blending two or more fruits pulp, Manay SN, Shadak sharaswamy N [2]. In jam, jellies sugar stops growth of microorganisms and prevent spoilage. Sugar holds water due to which shelf life of the products is increased, Clarke MA [3].

Stabilizing, thickening and textural characteristics are improved by pectin in different foods like jam, jelly, bakery products, confectionery and beverages, Wang Q et.al., Citric acid is essential to accurate balance, which is required in jam and jellies preparation

[4]. For the replacement of citric acid lime and lemon juice can be used in the jam preparation because lemon and lime juices have greater amount of citric acid, Desrosier NW, Desrosier JN [5]. Production of jam necessitates availability of raw materials and availability of other ingredients such as pectin, citric acid, sugar and jam jars at reasonable prices.

### Raw Materials

#### Selection of Raw Material

Fruits ideally suited to jam making having three factors in common, a high pectin content, relatively low PH and high total soluble solids. It should be pointed out that, during the maturation of fruit, there is continuous conversion of protopectin in the green fruit to pectin in ripe fruit, and ultimately to pectic acid in over riped fruit. The pectin level in fruit is definitely a far from static value. Any very green fruit is unsuitable for jellies because of the low pectin content although it is true that some of the protopectin in the very green fruit is converted to pectin as the jelly is boiled, this conversion is inadequate to form enough pectin for optimum gel formation, Net2.

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As fruit ripens, a natural conversion of protopectin to pectin is catalyzed by enzymes, and the pectin content is elevated as the protopectin level drops. The pectin, in turn, is gradually trans-formed into pectic acid as the fruit becomes very mature. This increase in pectic acid reduces the gelling ability of fruit. Fruit is optimum for making Jam when it is fairly ripe because the pectin content is at its peak and the levels of protopectin and pectic acid are low. Even when pectin content is at its peak in a fruit, some types of fruits contain inadequate quantities of pectin for successful gel formation, examples of fruits have low pectin include strawberries, raspberries, peaches, and apricots. Some fruit are naturally low in acid, hence are less suited to Jam preparation. Examples of a low – acid fruit is the banana – Another common fruit in this class is ripe sweet apples. Tart apples, berries, citrus fruits, and grapes are appropriately acidic for Jelly making. Adequate acid and pectin in fruits is important in fruit selection. Acid may easily be increased in fruit juice by the addition of lemon juice or other acid Commercial pectins, prepared from the skins and cores of apples or the albedo of the skin of citrus fruits are readily available in liquid or powdered forms to supplement the pectin in the fruit. powdered pectin is preferred by some people because it has long shelf life. Liquid pectins are very convenient in use, but an open bottle must be used soon before the pectin begins to break down, Net 2.

### **Sugar**

Sugar plays an important role in jam making and responsible for the sweet taste and act as preservative in addition to jell formation. It must be of high quality and having bright white color.

The way it is added and its treatment during the process of boiling are important factors affecting the finished product quality, Rauch [6].

### **Pectin**

Pectin is that group of substances derived from some fruits which form a colloidal solution in water, and derive from protopectin in the process of ripening of the fruit. under suitable conditions, pectin forms a gel. Pectin is carbohydrates found to a greater or lesser degree in the cell walls of all fruits and vegetables, (Net) 2.

Pectin is important ingredient in jam manufacture because of its gel –formation property, beside the jelly formation property of pectin it helps in reducing the boiling time, which in turn assist in preserving the volatile substances and prevent the excessive inversion of sugar.

The amount of pectin required for jam making depends on: the quality and quantity of the natural pectin in the raw materials; the contents of the soluble solids in the end product; type of pectin used and the nature of the recipe.

### **Acid**

Citric acid is the most popular acid used in jam manufacture and is added when the mixture reached 64% total soluble solids. Acid is added to jam in order to: Reduce the PH to the value recommended to apple/jelly formation; Increase the total acidity in order to enhance the flavor and taste; and preservative effect, Saeed, Mubarak [7].

### **Factors Affecting Production control of Jam**

Rauch stated that every factory has its own process of production and develops its own peculiar quality, yet there are certain factors applicable to all good quality jams those factors which should be established are: Total soluble solids content (T.S.S); The Sucrose – invert sugar ratio; Acidity & PH value; and Sugar /acid ratio [6].

#### **Total Soluble solids content of jam**

Most of the Food laws of the world provide for a minimum percentage of 66 percent total solids and a minimum fruit content of 45 percent. Jams of total solids below 66 percent will be subjected to spoilage by yeast and moulds due to high water activity content and will have very poor setting.

#### **Sucrose – invert sugar balance of the jam**

The sucrose – invert sugar ratio is very important in jam manufacture otherwise crystallization will occur during storage. Moyle recommended that jam with total soluble solids of 67 to 70 percent should have 20 to 28 percent reducing sugars, while Rauch preferred the figure to be kept within 28 – 32 percent [6]. The PH of the jam, boiling temperature, and time, are factors affecting inversion of sugar.

#### **PH of Jam**

PH affects the setting of the jam. The PH of the jam should be kept in the range of 3.2 to 3.4 A PH above 3.4 may lead to failure of jam may lead to failure of the jam to set while a PH value of less than 3.0 leads to bleeding of the Jam.

Norman Report that During the process of boiling sucrose solution in the presence of acid, hydrolysis occurs, in which reducing sugars are formed (dextrose and levulose). Sucrose is converted into reducing sugars, and the product is known as inverted sugar. The rate of inversion is influenced by the temperature, the time of heating, and the pH value of the solution.

Inverted sugar is useful in jell manufacturing, as crystallization of sucrose in the highly concentrated substrate is retarded or prevented. A balance is required between the sucrose and invert sugar content in jell formation. The amount of invert sugar present should be less than the amount of sucrose.

As much as the acidity of fruits varies, and boiling conditions vary, the maintenance of a desired invert sugar sucrose ratio is difficult. In vacuum concentration, little inversion of sucrose occurs. In this instance a portion of the sucrose should be replaced with pre-inverted sugar, Invert sugar is available commercially, and is usually acid hydrolyzed, although there are invertase enzymes which can be used to accomplish the hydrolysis.

#### **Coloring**

According to Noonan colors additives are constituents permitted for food [8]. It is probably one of the first characteristics perceived by the senses and is indispensable to the modern-day consumer as means of the rapid identification and ultimate acceptance of food.

#### **Technology of Jam Making**

The production of jam involves three major processing steps: pectin preparation, boiling and filling and sealing processing stages.

## Pectin Preparation

The production of pectin solutions by way of a suitable system is the best possibility to add standardized pectin to the cooking process. If only slow-speed mixers are available, the pectin is mixed with about five times the amount of sugar and this mixture is dissolved in water with a temperature of at least 80°C. In this way, a 3-5 % pectin solution can be produced. If a dissolver with high-speed mixer is available (more than 1.500 rpm), pectin is added while the mixer is running and the water temperature is at least 80 °C, directly poured into the mixer flux and dissolved. Depending on the type of pectin, pectin solutions of 5-7 % may be produced. Nowadays, 7-10% pectin solutions can be produced, on modern injection mixers.

The evaporating water volume is clearly smaller when such high percentage pectin solutions are added in the cooking process than it is the case with 3-5 % pectin solutions. If sugar solutions or sugar syrups are used, pectin may also be suspended in 10 times the amount of liquid sugar/sugar syrup while stirring slowly. This suspension may then be incorporated into hot water with at least 80°C, which results in a 3-5 % pectin solution. If pectin is directly added to the product batch, i.e., not as pectin solution, this is best achieved with the above-mentioned pre-mix of pectin and 5-10 times the amount of sugar or a suspension with liquid sugar or sugar syrups. In this case it is important to observe that the soluble solids content in the batch during the dissolving of pectin is not above 30 %, since it otherwise interferes with the solubility.

## Boiling

This concentration of jams is done with the objective to create a finished product with a long shelf-life and with the required soluble solids content. During cooking, a sufficient exchange between sugars, liquid medium and fruits is achieved, which prevents water loss in the finished product during storage. In the large-scale production of jams with cooking kettles two basic types exist for the concentration process: open system boiling and vacuum boiling. Cooking in an open kettle is nowadays practiced only in a few, small companies. Cooking in vacuum systems is done in closed kettles under reduced pressure. The great benefit of this cooking method consists in low cooking temperatures and short cooking times. Both criteria are decisive for an optimal finished product as regards to appearance, colour, flavour and vitamins, since the raw materials are exposed to only minimal stressing. Short cooking times and relatively large cooking batches also guarantee the economic efficiency of the process.

The pre-heated fruit/sugar mix is fed from the pre-heater by negative pressure into the kettle and reduced by boiling under vacuum with constant stirring. To prevent foaming, edible oils and fats such as mono- and diglycerides of edible fatty acids may be added. The pectin solution is then metered and further reduced by boiling under vacuum until the desired final soluble solids content is reached. Due to the low cooking temperatures, which may be as low as 65 °C, slow to medium rapid set pectins are applied in this process. Once the final soluble solids content is reached, the batch will be vented and acid is added. The temperature of the cooked material increases in this process, before discharging it should reach 80-85 °C in order to guarantee germ-free filling. Sophisticated cooking systems with flavour recovery condense the volatile

aroma components from the escaping steam and return them to the cooking batch before its discharge.

## Filling of Jams

Jams is discharged from the vacuum kettle by way of pumps or, even more sensitively, by gravity into heated filling troughs with agitators, from which they are fed into filling machines. The temperature of the cooking batch at the time of filling is 70-85 °C.

## The relatively high filling temperature and capping under vacuum with headspace sterilization

guarantees germ-free filling and perfect stability during storage. Before closing the jars, suitable measures for the sterility of the product surface during the filling process are recommended. UV-radiation of the empty jars or the caps before filling is also indicated to protect against secondary infections. After filling and capping, the jars pass through a tunnel cooler and are sprinkled with cold water which lowers their temperature to 40-50°C. The rapid lowering of the temperature prevents caramelization and colour changes in the filled article and brings the product into a temperature range; in which an optimal jam texture may be slowly formed. After cooling and labeling, the products go into packaging.

## The end points determination

Thermometer method: The thermometer must be accurately calibrated and fast Working. When designed concentration is reached usually the temperature is 105 c.

The Refractometer Method: The total soluble solids in jam can be exactly determined in a few seconds. Jam manufactures generally employ an Abbes refractometer for determining the end point. Adrop or two of the liquid is placed on the prism of the instrument, the prism being cooled by water jacket. The scale of the instrument is usually graduated in Brix degrees, consequently it is direct reading instrument Cruess [9- 16].

## Spoon Test

When the jam has been boiled for some times and has reached a reasonable consistency, dip spoon into it and let the product to run off the sides of the spoon.

If on cooling the product falls off in form of a unit instead of free flowing readily in single stream, it means that the end point has been reached.

» By placing some of the jam on dry sheet or surface of jar cover and turning the sheet or the cover upside down after few seconds.

If it does not run off that means the end point has been reached.

» By placing some of the jam in a cup filled with water,

if the color of the water did not change and the drop settled as solid matters at bottoms of the cup that means the end point has been reached.

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