PRODUCT DEVELOPMENT OF SOURSOP (Annona muricata L.) ICE CREAM MIXED WITH SOYMILK

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DISERTATION SUBMITTED IN PARTIAL FULFILLMENT FOR THE DEGREE OF BACHELOR OF FOOD SCIENCE WITH HONOURS (FOOD TECHNOLOGY AND BIOPROCESS)

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ABSTRACT

The main objective of this thesis was to determine the best formulation of soursop ice cream mixed with soymilk. Nine formulations of soursop ice cream mixed with soymilk were provided. Three formulations out of nine formulations were chosen in Balance Incomplete Block (BIB) Design. Seven-point hedonic test was conducted to choose the best formulation out of three formulations. Formulation 3 with 20% whipping cream, 20% soymilk and 30% soursop pulp has the highest value of score mean which is 5.40±1.17 hence; it is the most accepted and has been chosen as the best formulation out of three formulations. The best formulation was chosen to undergo proximate analysis, shelf life test, physical test and consumer test. The composition content of moisture, ash, protein, fat, crude fiber and carbohydrate were 60.34±0.997, 0.50±0.141, 3.42±0.297, 7.08±0.183, 15.71±1.06 and 12.96±0.799. The total energy content was calculated to provide information about energy content to consumer. The total energy content for soursop ice cream mixed with soymilk in 100g is 673.96kJ or 239.21kJ energy. Soursop ice cream mixed with soymilk was tested to determine the quality of product during storage (microbiological test and pair comparison test) for eight weeks of storage time. Physical test was conducted by calculated percentage of overrun of soursop ice cream mixed with soymilk. The total of overrun for soursop ice cream mixed with soymilk is 22.41±11.89. The percentage of overrun of soursop ice cream mixed with soy milk is low compared to the standard which made coarse texture because of the shrinkage of ice cream during storage was due to the loss of air from ice cream causing it to loss volume. Consumer test were carried out amongs 100 respondents and indicates that 91% of the respondents like the soursop ice cream mixed with soymilk while 95% showed their interest to buy the product in the market.
ABSTRAK

PENGHASILAN PRODUK AISKRIM DURIAN BELANDA (Annona Muricata L.) CAMPURAN SUSU KACANG SOYA

Objektif utama tesis ini adalah untuk memilih formulasi terbaik ais krim Durian Belanda campuran susu kacang soya. Sembilan formulasi telah disediakan. Tiga formulasi dari sembilan formulasi telah dipilih didalam Ujian Pemeringkatan BIB. Tujuh-titik ujian hedonik telah dilakukan untuk memilih formulasi terbaik dari tiga formulasi tersebut. Formulasi 3 dengan kandungan 20% krim putar, 20% susu soya dan 30% isi Durian Belanda didapat mempunyai skor min yang tinggi iaitu 5.40±1.17.

Formulasi ini diterima dan dipilih sebagai formulasi terbaik daripada tiga formulasi lain. Formulasi terbaik telah menjalani analisis proksimat, ujian mutu penyimpanan, ujian fizikan dan ujian pengguna. Komposisi untuk kelembapan, abu, protein, lemak, serabut karsa dan karbohidrat ialah 60.34±0.997, 0.50±0.141, 3.42±0.297, 7.08±0.183, 15.71±1.06 dan 12.96±0.799. Jumlah kandungan tenaga telah dikira sebagai rujukan kepada pengguna. Jumlah kandungan tenaga untuk aiskrim Durian Belanda campuran susu kacang soya diperoleh 100g aiskrim 673.96kJ atau 239.21kJ.

Ujian mutu simpanan telah dijalankan ke atas sampel (ujian mikrobiologi dan ujian perbandingan berganda) selama tempoh pengeceran 8 minggu. Ujian fizikal dilakukan dengan mengira peratus overrun didalam aiskrim Durian Belanda campuran susu kacang soya. Jumlah peratus overrun ialah 22.41±11.89. Peratusan overrun ini adalah rendah berbanding dengan piawai menyebabkan tekstur yang kasar kerana pengeceran aiskrim semasa penyimpanan kerana kehilangan udara dari aiskrim menyebabkan kehilangan isipadu. Ujian pengguna dijalankan ke atas 100 responden dan didapat 91% responden suka aiskrim Durian Belanda campuran susu kacang soya manakala 95% responden sangat berminat untuk membeli produk ini jika dipasarkan.
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CHAPTER 1

INTRODUCTION

1.1 Study background

Ice cream is a frozen sweetened cream often eaten as appetizer. It is enjoyed by people regardless of their age. It is suitable to eat ice cream most of all in a hot day. There are many types of ice cream available that include ice cream sticks, ice cream cones and ice cream in a container. In addition, the ice cream would not be out of place as dessert in hotels and functions.

Ice creams are easily available in the market. This is because ice creams are sold at affordable prices and highly demanded by ice cream fans. Price of ice cream is determined by the quality of the ice cream. The main objective of ice cream manufacturer is to produce product with an ice crystal size distribution that results in smooth texture and to preserve that ice crystal distribution until consumption (Flores & Goff, 1999). High quality of ice cream is often sold at higher price because of its smooth texture and lesser air composition in the cream. Ice cream consists at least four major discrete phases: ice crystal, air bubbles, emulsified fat and cryoconcentrated aqueous phase (Gelin et al., 1994).

Qualities of ice cream sold in the market are different from one manufacturer to other. The ice creams that are available in the market include chocolate ice cream, vanilla and strawberry ice cream. There are several terms that refer to the quality of
the ice cream. Some of the ice cream terms are superpremium, premium, low-fat, fat-free premium and so on. Quality of ice cream products are affected by raw materials and texture of ice cream produced. The melt-down rate of ice cream is affected by many factors, including the amount of air incorporated, the nature of the ice crystal, and the network of fat globules formed during freezing (Muse & Hartel, 2004).

Significant development of soursop ice cream mixed with soy milk is to introduce a new ice cream flavor with soursop (Annona Muricata L) flavor mixed with soy milk. According to Stanley et al. (1996), one of the goals of modifying ice cream formulation is to produce ice cream with desirable texture by enhancing the texture through improvement of ice cream physical structure (Lim et al., 2007). This is because such products are not really available in the market yet. Production of various products such as ice cream, jams, with soursop flavor are not yet recognized in Malaysia. Soursop is one of the popular exotic fruit in Malaysia. It has great potential in soft-drink industry. Soursop is easily rejected in the market because of external injury or uneven shape and size (Umme et al., 2001). Therefore, it is used in various manufacturing process such as nectars, syrup, shakes, jams, jellies, preserve and ice cream. Besides that, it also used as raw materials for powder, fruit bars and flakes. Soursop has great potential for exportation and its puree, juice or mixture of other juice is able to compete in the international market (Telis-Romers et al., 2007). In Malaysia, Institut Penyelidikan dan Kemajuan Pertanian Malaysia (MARDI) has produced some products based on soursop such as jam, puree and cordial (Khalid et al., 1993).

Soursop is known as ‘graviola’ in Brazil and ‘guariabana’ in Mexico. It is tropical fruit which cultivated throughout the tropical region of the world. Soursop prized for its very pleasant, sub-acid, aromatic, juicy flesh and distinctive flavor (Telis-Romers et al., 2007). Soursop fruit has high nutritional content and multifunctional
properties. It is packed with vitamin C, vitamin B1, and vitamin B12. Soursop also contains high in protein, carbohydrate and has healthy fat. Besides that, soursop also contains minerals such as calcium and iron (Thines, 2012). In addition, soursop also display as antitumour, pesticidal, antimalaria, antihelmintis, piscidal, antiviral and antimicrobial effect (Syahilda et al., 2012).

Further innovation is done by adding a small quantity of soy milk into the ice cream to increase the viscous properties than the elastic properties in dairy-based system (Adapa et al., 2000). According to Bisla et al. (2011), protein content of soy milk was found 4.23g/100g which was higher than the standard cow’s milk that contain 3.50g/100g of protein. According to Patel et al. (2000), ice cream with higher protein content had ice crystal smaller. This occurs because proteins have good binding capacity which can lower quantity ice crystal available because of less free water is available to bind. Protein adsorb firmly in ice crystal surface which can prevent the growth and formation of larger ice crystal. Since soybean seeds contain 40% protein and its protein and oil content are not only high in quality but also rated as best quality too, all the essential amino acids (O’kennedy et al., 1979; Bisla et al., 2011). Besides that, soy milk contain higher micro-elements such as Calcium(Ca) and Iron(Fe) compared with skim milk, hence can give great quality ice cream (Abdullah et al., 2003). Soy milk and milk may act synergistically to give a more firm texture (Laan & Truelsen, n.d).
1.2 Objectives

i) To determine the best formulation of soursop ice cream mixed with soymilk.

ii) To determine the proximate composition; and calculate the percentage of overrun in soursop ice cream mixed with soy milk.

iii) To examine the microbiological and sensory quality of the product during storage study.

iv) To determine the consumer's acceptability towards soursop ice cream mixed with soy milk.
CHAPTER 2

LITERATURE REVIEW

2.1 Ice cream

Ice cream is frozen complex colloidal system consists of partially merge fat droplets, air cells, ice crystal, continuous aqueous phase where polysachharide, protein, minerals are dissolved in it (Marshall et al., 2003). According to Dickinson (1992a), ice cream can be described as complex combination of semi-frozen foam and emulsion which partially consolidated with the emulsified fat and other by network of ice crystal with dispersed in aqueous solution of viscous macromolecules (Stanley et al., 1996). Besides that, ice cream can also be interpreted as complex food system that are categorized as solid foam of air bubbles stabilized by ice crystal and emulsified fat in an aqueous phase which contain soluble and degradable components (Gelin et al., 1994).

According to Bodyfelt (1983), there are two ways that consumer could specify the quality of ice cream. First is through the composition of ice cream such as milk fat, overrun, total solids and the types of flavor. The other is through many differentiations (composition, promotion, advertising and packaging) (Guinard et al., 1994). Ice cream is aategorized as foam. Foam is dispersion of gas bubbles in a continuous liquid phase, semi-solid and solid. Foam stability is important for the food, beverages, pharmaceutical fermentation, paper production, crude oil and chemical industry. Stable foam food will be sold in large quantities in the foam of meringues, soufflés, ice cream and dessert. Dairy products such as ice cream foam contain fat particles, carbohydrate, emulsifier and protein supplements. Foam can be classified
into two types, namely polyhedral foam and spherical foam. Spherical foam is spherical in shape and usually found when the diameter of air bubble is small, the surface tension is high and the volume fraction of gas is low. Polyhedral bubbles occur when there are large bubbles in the foam, the surface tension is low and the volume fraction of gas is high and the foam will deform to form polyhedral bubbles in the liquid films. An example of polyhedral foam is beer. Ice cream is categorized as sphere foam where there is a 50 percent air bubble usually with diameter of 20-60mm (Eisner et al., 2007).

Although ice cream industry is growing rapidly in the United States, ice cream was first introduced in Europe before it is growing rapidly in the United States (Bhandari, 2001). In 1905, Ice cream production capacity in the United States reaches 5 million gallons. Development and level of economic growth in the United States at that time encourage ice cream entrepreneurs to export their products to other countries. However, the product that is produced at that time did not have any guidance of the quality and ingredients (Marshall et al., 2003).

The origin of ice cream is from Europe and subsequently introduced in the United States where it was developed on a large scale. In the first century, it is believed that ice cream and iced drink was developed from ice and ice drinks. At that time, it was believed that wine and fruit juice was cooled with ice and snow was taken from the mountains. Unfortunately, there is no clear explanation exists except snow and ice was used to cool and freeze sweet dessert. These ideas may have originated from ancient Egypt and Babylon where sweets and cakes were frozen to prevent damage. Ice cream was introduced in the United States by the British. In 1851, the first ice cream industry in the United States was established by Baltimore and Maryland by Jacob Fussell. In addition, Ice cream plant was set up in New York, St. Louis and Chicago. Development of condensed milk and flour, introduction of
pasteurizer and homogenizer increased development of freezing and growth of industry in 1900. Ice cream soda was first introduced in 1879 and the ice cream cone and Eskimo Pie was introduced in 1904 and 1921. In around 1920, ice cream has been recognized as important food and the product became very popular at that time. Good cooling device development, transport, refrigeration units in the house, good packaging, marketing and product standard have been set where resulted in ice cream widely available to consumer (Marshall et al., 2003).

When ice cream was first introduced commercially in North America, the materials used are cream, evaporated milk, sugar, eggs and gelatin. After that, the condensed milk, nonfat dry milk (NDM) and butter become popular ingredients for the preparation of ice cream. Technological developments and changes in the market have encouraged the development of variety materials that are readily available from various sources. Fat dairy products such as milk and NMS have been an important role in ice cream. Non-dairy products such as sweeteners, stabilizers, emulsifiers, egg products, fruits, nuts, flavor, specialty products and water give large effect to the mix (Marshall et al., 2004).

Ice cream productions in industrial scale are governed under the act and standards of that country. For example, In the United States, the use of the raw materials for the production of ice cream is set by the U.S Food and Drug Administration. Standard in the United States has set that 10% milk fat, 20% of total solids and a mixture of sweeteners and flavorings are allowed to produce an ice cream (Marshall et al., 2003). In Malaysia, the manufacturer must ensure the production of ice cream follows the standards set out in the Malaysian Food Regulations 1985. According to the Rule 116 of the Malaysian Food Regulation 1985, the ice cream should be made from milk or milk products with milk fat, vegetable fat, cream, butter and sugar or a combination of these, and may contain other ingredients that are safe
to eat. In addition, ice cream must contain not less than 10% milk fat or vegetable or any of this combination. Ice creams also contain permitted coloring substance, permitted flavoring substance and permitted food conditioner.

There are several processes performed to produce ice cream. Production started with the process of combining the ingredients into a homogenous mixture, follow by pasteurized, homogenized, chill, stored for aging, mixed with flavoring and finally kept cold (Marshall et al., 2003). In order to get good quality of ice cream, it is very important to choose dairy products and other ingredients that yield higher quality ice cream and when materials is mixed, can produce ice cream with smooth and delicate texture and flavor (Bhandari., 2001).

In the ice cream industry, there are things that need to be considered to control the texture of ice cream. Freezing process is complete when the frozen aerated product undergoing freezing at temperature reach -180°C or 250°C to -300°C. During the hardening process, the water will freeze and influences the formation of crystal nucleation. Typically, the ice crystal in ice cream freezer will be decreased from the sizes less than 30 to 35 mm and will increase in size after hardening from less than 45 to 50 mm. There are many factors that affect the phase behavior of ice. One of the factors is the effect of sweetener. The higher the concentration of the sweetener, the lower the volume of the ice phase (Hartel, 1996; Flores & Goff, 1999). Also, the dynamic whipping process incorporates air bubbles into the mixture. According to Thomas (1981), an increase in air-cell dispersion causes a reduction in thickness of the unfrozen phase, which would result in limiting the size of ice crystal by mechanical hindrance of the numerous air cells and fat structure (Flores & Goff, 1999). Besides that, low overrun induces the formation of coarser ice crystal in ice cream compared with the same formulation made at higher overrun, because in a
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