Indonesia International Institute for Life Sciences

# ENRICHMENT PROGRAM REPORT

# Improvements of Textural Properties and Flavor Variants in Carrageenan-based Pre-mix Jelly Powder

STUDY PROGRAM
**Food Science & Nutrition**


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INDONESIA INTERNATIONAL INSTITUTE FOR LIFE SCIENCES (i3L)
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*< Title Page for School of Life Sciences>*

**INTERNSHIP REPORT**

# Improvements of Textural Properties and Flavor Variants in Carrageenan-based Pre-mix Jelly Powder

By
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in partial fulfillment of the enrichment program for the Bachelor of
Food Science and Nutrition

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|---|---|
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We hereby declare that this EP project is from student's own work. The EP Report has been read and presented to i3L's Examination Committee. The EP has been found to be satisfactory and accepted as part of the requirements needed to obtain an i3L bachelor's degree.

Approved by,

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# ABSTRACT

PT Xumei Food Tech Indonesia is a flavor house company that focuses on flavor production and application while utilizing the business-to-business concept. The author conducts her internship in this company under the research and development department for 4 months with a daily weekday work schedule of from 8.00 a.m. to 5.00 p.m. One of the projects handled was to formulate chocolate pre-mix jelly from a carrageenan powder base provided, and also the suggestion to add fruity flavors as well. Carrageenan is a hydrocolloid that has been widely used in the dessert industry, however, it has a harder texture in comparison to konjac, causing the utilization of food-grade salts as well as organic acids to be involved in making the textural properties similar to those of the commercial ones. The suitable concentration for potassium citrate and citric acid was able to be finalized and the prototype was submitted to the customer, where the fruity ones have a higher concentration of citric acids as the types of tropical fruits tend to be perceived as sour ones. Both texture and flavor play an important role in food palatability as flavor comprises non-volatile and volatile that are released when food is ingested and texture contributes to the mouthfeel. Despite all that, after gaining lots of experience and also being able to apply her theoretical knowledge, the internship has helped the author learn lots of practical and extensive knowledge that has not been covered during her years of studies.

***Keywords:*** *Carrageenan, Flavor, Internship, Jelly, Sensory Evaluation, Texture*

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# TABLE OF CONTENTS

# LIST OF FIGURES, TABLES, AND ILLUSTRATIONS

**List of Figures**



**List of Tables**

# LIST OF ABBREVIATIONS

R&D: research and development

e.g.: for example

# INTRODUCTION

## 1.1. Brief History and Company Profile

Xumei Shanghai Food Tech Pty. Ltd. is a Sino-foreign joint venture that has been established as a prominent flavor house in China, with more than 25 years of experience in the food flavor and fragrance industry on flavor production and understanding food trends. It has a marketing strategy of "growth in China, focuses in Asia, and view for global", committed to delivering the most innovative and best flavor quality to clients. The global headquarters was constructed in Shanghai in 1995, comprising of management, marketing, research and development, and food safety control. The production bases and plantations are located in several areas in China, and the main one is located in Henan province and covers up to 60,000 square meters. In addition to that, Xumei believes in the natural future trend in the food and beverage industry, which then led to the construction of the Natural Ingredients R&D Center in 2007, and after several years of effort, they have achieved great results in the natural flavor and food ingredients. It has accumulated rich experience in natural and synthetic flavors, natural tea aroma extracts of premium quality, and plant concentrates. Not only that, the supply capabilities are also flexible where it has passed the ISO, HALAL, SC, and other certification systems that could meet different application demands.

The expansion to Indonesia was then carried out where in 2020, PT Xumei Food Tech Indonesia was built with a certified manufacturing and laboratory facility, covering up to 2,700 square meters and strategically located in Jakarta. It is projected with an annual manufacturing capacity of 1,500 tonnes of flavor, equipped to be able to handle any project, and has been ISO and MUI Halal certified. Furthermore, it is facilitated by both the creation and application lab that could develop new flavors or refine the existing ones to meet the needs of clients and provide a comprehensive range of services to support the customers through the product formulation and development process.

Moreover, the Indonesian company also offers a wide variety of products, covering various synthetic flavors, tea extracts, and enzymolysis grain powder. The synthetic flavors, as can be seen in ***Figure 1(i)*** in liquid form and ***Figure 1(ii)*** in powdered form, are made from food-grade ingredients that have been BPOM certified to replicate the natural aromas or current trends for an enjoyable sensorial experience. The tea extracts, as shown in ***Figure 1(iii)***, are made from premium tea leaves through careful selection to be processed with water extraction, followed by aroma recovery so that the concentrate has a rich aroma and taste of the fresh-brewed tea. The last product, which is the enzymolysis grain powder is made from biological enzyme hydrolysis and spray drying technology with high efficiency and specificity under mild conditions, to convert the starch in grains into dextrin, oligosaccharides, and glucose that is higher in solubility, stability, and also yield. The plant-based enzymolysed grain product (***Figure 1(iv)***), e.g. brown rice or oat has better taste, digestion, and absorption characteristics as it could act as an excellent source of dietary fiber and protein, which greatly enhances the creaminess and mouthfeel for the application in bakery and dairy products or even as a meal replacement.

***(i)*** ***(ii)*** ***(iii)*** ***(iv)***


***Figure 1.*** Products of PT Xumei Food Tech Indonesia ***(i)*** Liquid Synthetic Flavor ***(ii)*** Powder Synthetic Flavor ***(iii)*** Concentrated tea extract ***(iv)*** Enzymolysis grain powder

## 1.2. Vision and Mission

PT Xumei Food Tech Indonesia has a mission to build stronger relationships with Indonesian clients and better understand the unique needs and preferences of the Indonesian market. On the

other hand, there are 4 core values or visions that are maintained, which include: integrity, innovation, professionalism, and collaboration.

1. Through **integrity**, the highest standards for the quality and safety of the products made are maintained, where starting the sourcing of the ingredients and testing and labeling are honest and transparent.
2. Whereas in **innovation**, boundaries are constantly extended to serve the customers better and create new flavor profiles.
3. The team is also expected to be **professional** so that the clients are satisfied with the service provided and the best flavor solutions can be delivered.
4. Last but not least, by **collaborating** with customers, suppliers, and partners, greater success could be achieved when everyone is involved in working together.

### 1.3. Organizational Structure


***Figure 2.*** *The overall organizational structure of PT Xumei Food Tech Indonesia*

There are several departments and divisions within the company, namely the research and development (R&D), purchasing, sales and marketing, PPIC and warehouse, production, information technology (IT,) and quality, which are further divided into quality assurance (QA) and quality control (QC). The research and development department focuses on innovation and reformulation of flavors or product prototypes, purchasing is responsible for ensuring all the essential needs of the staff for the company are fulfilled and at the same time directly communicating with suppliers, while sales

and marketing mostly deal with the customers or clients directly, acting as the face of the company. The quality department, on the other hand, was responsible for the quality of the flavors produced by the production department, and as the name suggests production was responsible for making large batches of flavors to be delivered to clients. PPIC and warehouse were more of the stocking of flavors and incoming raw materials and lastly the information technology (IT) department mainly was to ensure that the systems and websites used within the company ran smoothly.

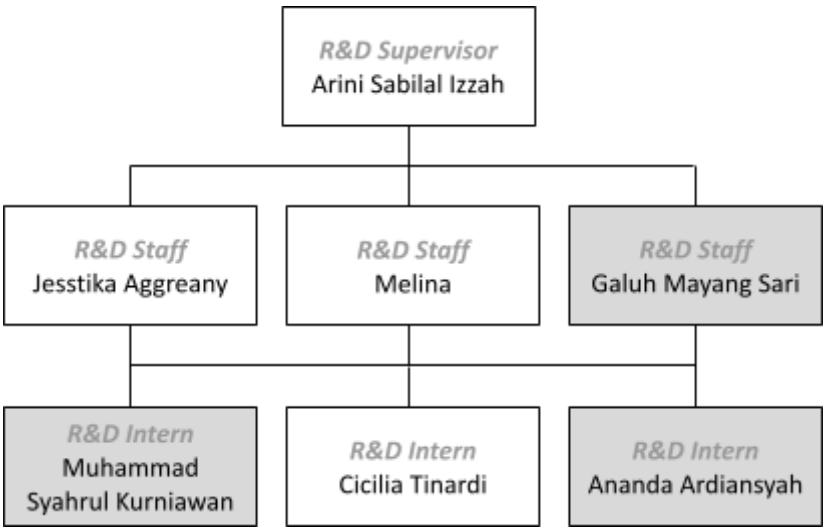


***Figure 3.*** *Organizational structure within the research and development department*

*note: grey box indicating that the personnel has left the department

The author is under the research and development division, involved in both flavor creation and application as well as part of both the sweet and savory departments. Several projects are mostly done according to the requests made by the customers, where the author's job is mainly to help and assist the supervisor in the creation of the flavor along with application into food and beverage products.

# INTERNSHIP ACTIVITIES

## 2.1. Daily Activities during the Internship

During the internship, the author's main job is to support the research and development supervisor and staff in completing the project. The intern was obliged to come at 8.00 a.m. in the morning on weekdays from Monday to Friday, which the day starts by turning on the analytical balance in the morning and then continuing with the assigned tasks depending on the project that is done on the day. The working time ends at 5.00 p.m. when the intern is required to clean the bench and equipment used and also return the flavors to the specific location according to the label on the bottle or pouch after the project is done.

### 2.1.1. Flavor Creation and Development

The author took part in flavor creation, where the tasks mostly revolved around the addition of volatile compounds or chemicals into the specific flavor base to create flavors in various directions in accordance with the formulations given by the staff or supervisor. The flavor character may be classified into its top, middle, and base 'notes', where the raw materials providing for a certain note may adversely affect the other notes present in the flavor, hence a vast amount of experience and artistry are needed to create well-balanced flavor notes (Manley & Ahmadi, 1995). However, depending upon the customers' request, the flavor submitted may be modified and reformulated to their specific needs, for example in the creation of hazelnut flavor where the customer wants the direction of the hazelnut to be nuttier than the ones that we have in the flavor bank, hence, in this case, there is a new development of flavor from the existing through trials and error of mixing. Not only that, certain cases where there is a need to convert the liquid flavor in the inventory into its powder form, hence a plating technique using flow agents such as silicon dioxide was implemented, as it is the most common and also simplest method to be used (Nurhadi et al., 2024).

### 2.1.2. Trial and Sensory Evaluation

The majority of the author's tasks revolve around the trial and sensory analysis, in which after a certain flavor has been developed, it is tested in a sugar or salt solution depending on the direction or focus. The sugar solution of brix 8 was used for both liquid and powdered sweet flavors, whereas the salt solution was for savory flavors, and in the case of oil-based savory flavor, the liquid was first plated with salt before it was added with (warm) water. The sensory evaluation was then conducted descriptively by sniffing the aroma and tasting the flavors, where both qualitative and quantitative aspects were delivered by the trained panels (Murray et al., 2001).

In the case of the application of flavor to food or beverage products, the trial was first conducted to make the product prototype and then followed by sensory evaluation in terms of the appearance, smell or aroma, flavor or taste, texture, and overall liking towards the product. The description of the sensory properties imparted was standardized using a sensory lexicon, which comprises the vocabulary for the attributes of the food or beverage category along with its descriptors (Bless et al., 2024). Reformulation and further development were conducted if the prototype made was still not according to the requirements and the trial was conducted on repeat until the product made was satisfactory.

### 2.1.3. Customer Submission

Most of the samples made are for customer submission, hence powdered flavor was filled into an aluminum pouch, and the liquid flavor was poured into a sterile glass bottle depending on the weight of samples, which usually was 10 grams, and then were packed into plastic ziplock. If prototype samples were requested instead of flavor, it was packed into plastic cups or bags of different sizes depending on the product type and then sealed. Both flavor and prototype were then placed in Xumei's tote bag to be given to the customer.

### 2.1.4. Visitation

There are times when the interns are rolled into another department to learn more about the other division, one of which is the sales and marketing team. The sales and marketing departments are mostly responsible for implementing marketing strategies by reaching out to customers, and becoming the bridge between the research and development and the clients (Lyus et al., 2011). Thus, there are certain times that the author join them for visitation to several different companies, and the author's role there was to serve the prototype samples to clients as well as noting down the important feedback from the clients, whether it is on the flavor or prototype samples. After the visitation, usually, the feedbacks are communicated with the sales and marketing supervisor as well as the research and development staff that is responsible for handling the project.

### 2.1.5. Flavor Data Input

Some flavors and flavor bases are imported directly from the headquarters as requested due to the research and development department here is unable to create or innovate certain new or unique flavors, e.g. tea and brown sugar. Hence, the incoming flavors need to be inputted into the system including their expiry date so that they can be traced and tracked for the remaining weight as well as their location when it is needed for creation or application. In addition to that, some of the flavor used may remain a little or run out, which the bottles are compiled into together on a certain tray, then during the data input, the flavor that has the existing batch remaining would be disposed of.

### 2.1.6. Market Research

Approximately every 1-2 months, the research and development team along with the sales and marketing team would conduct market research on the local supermarkets to

see the current and ongoing trend of food and beverage products along with the flavors that are commonly used in the trends (Gaikwad & Yadav, 2020). Several unique products or existing products with unique flavors are purchased and most of the time, a hedonic test is conducted to see the liking towards the product and whether it could serve as an inspiration for a new product or flavor innovation.

#### 2.1.7. Sensory Panel Leader

Mostly after the interdepartmental meeting on Monday, a sensory evaluation of the end product will be conducted on imported foods and drinks from China or those with unique flavors in the current market. The sensory evaluation would be done by placing the food or beverage product in tasting cups, and then a hedonic test would be conducted and the product would be scored based on the liking on the form as shown in ***Appendix 1.*** (Torrico et al., 2018). Moreover, there are also certain cases where sensory evaluation needs to be conducted, such as when there is a big batch production of flavor ordered by a customer however, a problem is encountered where there is a difference in either the aroma or taste of the flavor, hence a triangle test needs to be conducted to see whether there is a difference (Sinkinson, 2017).

## 2.2. Difficulties Encountered

The author was also able to apply several theoretical and practical knowledge learned during the university to the working field and gain new insight on several new knowledge while working industrially since the lesson on flavor technology and chemistry was only covered in the last semester of university. Regardless of the knowledge and experience obtained from the internship, the author also encountered difficulties. Since the internship was conducted industrially outside of the campus, it is quite challenging to adapt to a new environment and technologies with different rules and regulations. Moreover, the projects done in the company were also quite fast-paced hence

within a week, there could be more than three projects being done or handled at the same time. In addition to that, there were also difficulties in managing and dividing the time to do the internship report and working on the projects at the same time, which was quite time and energy-consuming simultaneously. However, despite all of these challenges, the author managed to schedule her time to write the logbooks and report while doing the project. With support from the staff and other interns as well, the author managed to adapt and locate the ingredients and flavor in the laboratory within a few weeks and was able to do several projects independently.

# PROJECT DESCRIPTION

## 3.1. Introduction

### 3.1.1. Project background

Jelly is a food product with a chewy and soft texture that has a high fiber content, typically made from konjac or glucomannan flour along with sweetener and other additives to strengthen its texture, and is widely consumed as a dessert or as a mixture in drinks (Herawati & Kamsiati, 2022). The gel system in jelly is an essential criterion that affects the finished product's quality, which highly depends on the gelling agent and sugar used. Consumers of all ages are familiar with the gel textures from commercial jellies that are manufactured from κ-carrageenan and sugar. Therefore, a proper ratio between the konjac and secondary gum, such as κ-carrageenan in a sugar mixture is necessary to achieve the desirable texture (Akesowan & Choonhahirun, 2014).

Carrageenan is commercially sold hydrophilic colloids that are derived from numerous species of red seaweed that can act as a vegan alternative to gelatin and thickening agents as it has gel-forming and viscosifying properties (Necas & Bartosikova, 2013). It has been used for centuries in the production of jellies and milk pudding, however, there are certain limitations to this, which include the high brittle and low flexibility characteristics as well as their tendency for moisture separation, also known as syneresis, which could influence the final textural properties of the product (Tunieva et al., 2021). Due to this, the jelly hardness tends to be higher for carrageenan-based jelly in comparison to commercial konjac jelly, leading to a less chewy texture, and thus, the addition of food-grade salts such as potassium citrate may help in achieving the desirable texture properties (Wang et al., 2020)

Texture is a sensory and functional manifestation of structural, mechanical, and surface of food products that are detected through the senses of vision, hearing, touch, and kinesthetics which could be classified into several parameters: hardness, firmness, and

softness (Szczesniak, 2002). The texture of jelly or agar-agar products serves as a key parameter in determining its quality, hence the concentration of κ-carrageenan used in jelly formulation plays a crucial role in the gel network formation that imparts the desirable characteristics (Basmal, 2021; Handayani et al., 2024). Furthermore, the flavor is added to jelly products as its main role in food processing is to increase food palatability through the sensation produced by a material that could be perceived through the senses of taste and smell (Wong, 2018). Flavorings are added to foods in very small quantities, roughly between 0.1-2% to create a characteristic in bland food products, such as candies and snacks (Al Saqqa, 2022).

### 3.1.2. Aim

This project aims to identify the most appropriate formulation that matches the flavor and textural properties of the final jelly product with the commercially available ones in the market.

### 3.1.3. Hypothesis

The null hypothesis ($H_0$) is that there would be no difference in the textural properties of the final jelly product after the utilization of food-grade salts and acids. In contrast, the alternative hypothesis ($H_1$) is that there would be a difference in the textural properties of the final jelly product after the utilization of food-grade salts and acids in the premix.

## 3.2. Methodology

### 3.2.1. Variables

#### 3.2.1.1. Potassium citrate

Potassium citrate has a molecular formula of $C_6H_5K_3O_7$ with a white, hygroscopic crystalline powder appearance. It is odorless however with a saline taste and was generally used as a food additive, mainly as a stabilizer or buffer (NCBI, 2024).

#### 3.2.1.2. Citric acid

Citric has a molecular formula of $C_6H_8O_7$ with a colorless, translucent crystal appearance (NCBI, 2024), having an odorless smell with a strong acidic taste. Citric acid is generally used as an acidifying agent and has wide applications in the food and beverage industry for acidulation, flavor enhancement, preservatives, and synergistic agents (Swain et al., 2012).

### 3.2.2. The overall methodology of jelly production

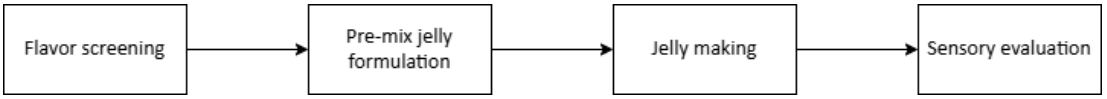


***Figure 4.*** *The overall methodology of jelly production*

There are 4 main steps in the production of jelly: flavor screening, pre-mix jelly formulation, jelly making, and lastly sensory analysis. Flavor screening would be the most essential step since it would determine the flavor output to suit a certain product. The next step is the pre-mix jelly formulation, which would include the addition of flavor as well, then followed by a jelly-making or cooking process. Finally, sensory evaluation would be

conducted from certain respondents as representative of whether the jelly needs to be further developed or reformulated.

### 3.2.3. Flavor screening

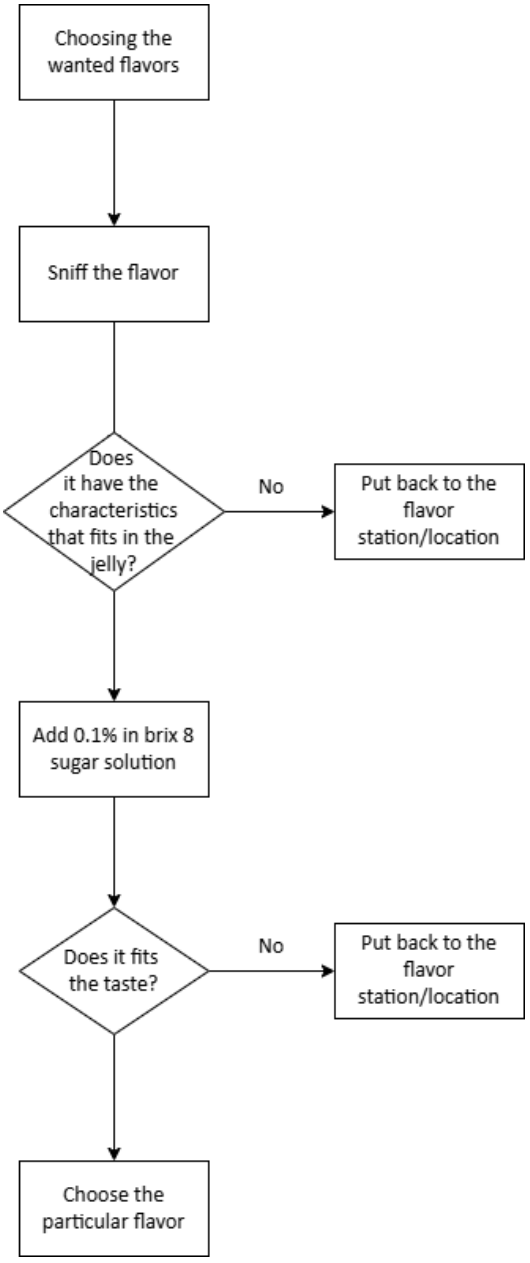


***Figure 5.*** *Methodology of flavor screening*

Flavor plays a crucial role in food and beverage products as it causes the product to be sensorially acceptable (Sharif et al., 2017). Hence, this flavor selection or screening

process must be done cautiously, and getting advice from the experts on the concentration and the direction of both aroma and flavor to make it suitable for application. The flavor must both be sniffed and ingested for the aroma and its direction to be tested, and a sugar solution of brix 8 was used in helping the flavor characterization, but a varying concentration of sugar solution could be used depending on the food or beverage category.

### 3.2.4. Pre-mix jelly formulation

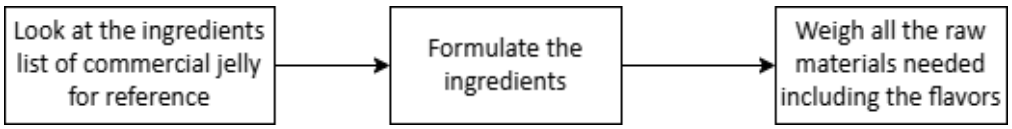


***Figure 6.*** *Methodology of pre-mix jelly formulation*

The ratio of the raw materials is first formulated similarly to the commercial jelly, and from there it would be adjusted and further reformulated depending on the sensorial properties after trial. All the dry raw materials and flavors used are then weighed accordingly in a total of 30 grams, as displayed in ***Table 1*** for chocolate variants and ***Table 2*** for fruity variants, in every batch and dry mixed together so that they would be homogenized.

***Table 1.*** *Chocolate pre-mix jelly formulation*

| No | Raw materials | Trial (g) | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** |
| 1 | Carrageenan powder | 8 | 8 | 8 | 6 | 5 | 5 |
| 2 | Non-dairy creamer | 14 | 14 | 14 | 14 | 14 | 14 |
| 3 | Maltodextrin | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4 | Citric acid | | | | 0.3 | 0.3 | 0.3 |
| 5 | Potassium citrate | 1.5 | 1.5 | 1.5 | 1.5 | 2 | 2.5 |
| 6 | Chocolate A flavor | 1 | 1 | 1.5 | 2 | | |
| 7 | Chocolate B flavor | | | | | 1 | 1 |
| 8 | Cookies and cream flavor | | | | | 0.5 | 0.5 |
| 9 | Cocoa powder 350 | 2.8 | 2.5 | | | 2.8 | 2.8 |
| 10 | Cocoa powder 500 | | | 2.8 | 2 | | |

*note: grey box indicating that the trial column was selected for customer's submission

***Table 2.*** *Fruity pre-mix jelly formulation*

| **No** | **Raw materials** | **Trial (g)** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| 1 | Carrageenan powder | 5 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 2 | Non-dairy creamer | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| 3 | Maltodextrin | 7 | 8.2 | 8 | 8 | 8 | 8 | 8.2 | 8 | 8 |
| 4 | Citric acid | 2.5 | 1.2 | 0.7 | 0.5 | 0.5 | 0.5 | 0.7 | 0.3 | 0.3 |
| 5 | Sodium citrate | 0.5 | 0.5 | | | | | | | |
| 6 | Potassium citrate | 1 | 0.8 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| 7 | Strawberry flavor | 1.5 | 1.5 | 1.5 | 1.5 | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Mango A flavor | | | | | 1.2 | | 1.5 | | |
| 9 | Mango B flavor | | | | | | 1.2 | | | |
| 10 | Taro flavor | | | | | | | | 1 | 0.7 |
| 11 | Vanilla flavor | | | | | | | | | 0.3 |

*note: grey box indicating that the trial column was selected for customer's submission

3.2.5. Jelly making

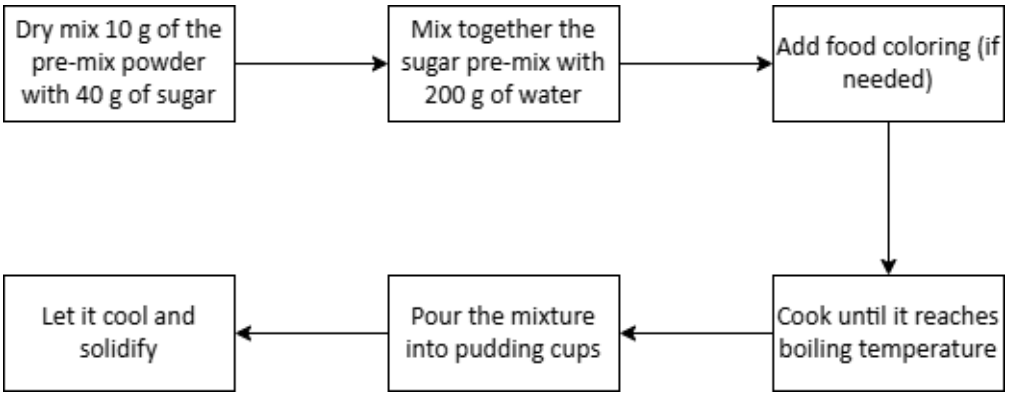


***Figure 7.*** *Methodology of jelly making process*

The previously made dry jelly pre-mix is taken 10 g, added with 40 g of sugar, and mixed together with water on the pan. Subsequently, food coloring is added depending on the flavor variants that are made, e.g. pink for strawberry, and then heated until it is boiling. The boiled mixture is then poured into jelly cups each containing around 80-90 mL and let cool to ambient temperature until it solidifies and then kept in the refrigerator until it is tested for sensory.

### 3.2.6. Sensory Evaluation

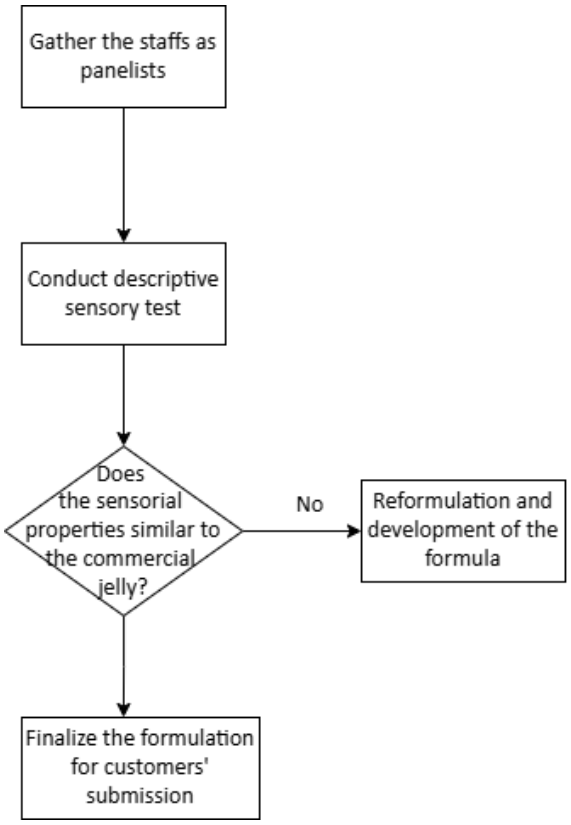


***Figure 8.*** *Sensory evaluation methodology*

Lastly, the data should be obtained from the panelists to identify which samples with a similar texture and flavor to the commercial or control are preferable. The panelists were gathered from the sales and marketing as well as research and development staff internally, and then a descriptive sensory analysis on the appearance, aroma, texture, taste, and overall liking was conducted. The data was gathered afterwards and either development or reformulation will be conducted if the sensorial properties still do not suit the commercial jelly product in the market.

### 3.3. Results and Discussion

In order to determine the textural properties and flavor variants of the final jelly product, the formulations for the jelly pre-mix were determined. Those two are crucial factors that determine the palatability of jelly, and the results are displayed in both ***Table 3*** and ***Table 4*** below.

***Table 3.*** *The descriptive sensory results of the chocolate pre-mix jelly formulation*

| Trial | Properties | |
|---|---|---|
| | **Texture** | **Flavor** |
| 1 | Hard, highly brittle, and not elastic | Only sweet, less chocolate with a slightly bitter cocoa taste |
| 2 | Hard, highly brittle, and not elastic | Only sweet, less chocolate with a less bitter cocoa taste |
| 3 | Hard, highly brittle, and not elastic | Sweet chocolate with a much stronger bitter cocoa taste |
| 4 | Less hard, slightly brittle, and less elastic | Sweet milky chocolate flavor with a strong cocoa taste |
| 5 | Just right, not brittle and elastic | Sweet milky and creamy dark chocolate taste with a bitter cocoa taste |
| 6 | Just right, not brittle, and slightly more elastic | Sweet milky and creamy dark chocolate taste with a bitter cocoa taste |

*note: grey box indicating that the trial column was selected for customer's submission

**Texture**

The texture of the jelly comes from the carrageenan, which undergoes a series of complex gelling processes, influenced by the temperature, type, and concentration of cations, particularly $K^+$ and $Ca^{2+}$ along with the type and carrageenan concentration (Stanley, n.d.). Generally, the gelation process involves the transition from coil to helix and polymers through heat treatment so that random coils exist in the solution. Followed by the cooling process, where the polymer chains interlinked together to form a double helix, which then aggregates to create a 3-dimensional spanning network regardless of the presence of counterions (Geonzon et al., 2020). However, carrageenan-based jelly tends to have a harder texture in comparison to the ones made from konjac as it would be more elastic (Basmal, 2021), which explains the result in ***Table 3.***, whereas the weight of carrageenan powder decreases in ***Table 1.***, the texture of the jelly powder would be less hard. Furthermore, adding sugar could affect the jelly's texture as it further enhances and strengthens the gel made by carrageenan, which results in stronger gels and higher hardness for the textural properties of the jelly made by carrageenan (Stenner et al., 2016).

Hence, an addition of food-grade salts, for example, potassium citrate may help in achieving the desirable texture for jelly products. Potassium citrate comprises of potassium ion and citrate, where the potassium ion has a stronger affinity towards carrageenan, and only small concentrations are needed to form a gel at room temperature in comparison to other monovalent ions such as sodium (Wang et al., 2022). Besides, the citrate in potassium citrate is a salt of citric acid, thus it can dissociate into citric acid and hydroxide salts, causing it to give a synergistic effect with the organic acids, e.g. citric acid that was used in ***Table 1.*** (Apelblat, 2014; Carocho et al., 2018). The citric acid added in the formulation hydrolyzes the carrageenan through the reduction in the formation of α-helix structure, which decreases the gel formation ability but at the same time facilitates the formation of hydrogen bonds. However, at a pH of 4.5, the citrate buffer might mix with citric acid, preventing further disintegration of the structure (Fauzi et al., 2023). Therefore, potassium citrate could strengthen the gels due to the presence of potassium ions but at the same time, the citrates

could dissociate to citric acid and reduce gel formation as low as a pH of 4.5, making a suitable pH buffer for jelly production and giving a more elastic texture (Branen et al., 2001).

**Flavor**

The other important attribute of food and beverage quality control includes flavor, which is the combination of tastes such as non-volatile compounds, aromas such as volatile compounds, and chem-esthetic sensations (Menis-Henrique, 2020). The utilization of flavor for this specific chocolate variant is also to impart the fruity, nutty, floral, and spicy aromatic notes of cocoa and at the same time cut down the addition of cocoa powder into the final pre-mix (Becerra et al., 2024). This is due to the rise in the global demand for cocoa with the increasing sales of chocolate confectionary products, however, there has been a supply deficit for cocoa as there are several uncertainties in cocoa growth which include climate changes, diseases, and weather variations in the areas of cocoa plantation (Myers, 2023). Hence, for the final formulation that was selected, two types of flavor are used, which are chocolate B and also cookies and cream flavor.

The author chose chocolate B as the flavor due to the higher ratio of ethyl maltol during the flavor creation, which imparts a sweet, caramelic flavor that is generally present in vanilla (Bracken-Clarke et al., 2021). In addition to that, chocolate B flavor also utilizes cocoa powder 350 in its production, which further boosts up the cocoa powder added into the pre-mix and enhances the natural color and flavor in the final jelly product (Biehl & Ziegleder, 2003). Moreover, the cocoa powder 350 was highly preferable than the cocoa powder 500 due to its lower alkalization during the roasting process of cocoa powder production. The cocoa alkalization process can develop a Maillard reaction, especially on the non-enzymatic brown compounds, resulting in a much darker color that could influence the appearance also a much milder and less harsh flavor (Li et al., 2012). Concerning the strong cocoa flavor, the cookies and cream flavor were added to the pre-mix to boost the vanilla, milky, and sweet flavor in the final jelly product to balance out the milk and dark chocolate taste.

***Table 4.*** *The descriptive sensory results of the fruity pre-mix jelly formulation*

| Trial | Properties | |
|---|---|---|
| | **Texture** | **Flavor** |
| 1 | Slightly hard, brittle, and elastic | Very strong sour taste with a fruity strawberry flavor |
| 2 | Very hard, highly brittle, and less elastic | Strong sour taste with a fruity strawberry flavor |
| 3 | Just right, not brittle, and slightly more elastic | Sour and sweet taste to balance the fruity strawberry flavor |
| 4 | Just right, not brittle, and slightly more elastic | Less sour taste with a fruity strawberry flavor |
| 5 | Just right, not brittle, and slightly more elastic | Less sour taste with a fruity mango flavor |
| 6 | Just right, not brittle, and slightly more elastic | More of a sweet taste with a fruity mango flavor |
| 7 | Just right, not brittle, and slightly more elastic | Sour and sweet taste to balance the fruity mango flavor |
| 8 | Just right, not brittle, and slightly more elastic | Strong earthy aroma with a sweet and starchy taro taste |
| 9 | Just right, not brittle, and slightly more elastic | Slight earthy aroma with a milky, sweet and slightly starchy taro taste |

*note: grey box indicating that the trial column was selected for customer's submission

**Texture**

The texture of the jelly was found to be in the highest hardness on trial 2 as shown in ***Table 2.,*** where the utilization of carrageenan powder was found to be at its highest concentration along with the lowest concentration of food-grade salts. However, the utilization of citric acid was found to be four times the amount from the ones in ***Table 1.***, which explains the more elastic texture of the jelly product. The choice of the food-grade salts may also influence and contribute to the texture obtained in trials 1 until 3 as in the study by Mangione et al. (2005), it was stated that carrageenan was found to be in the coil state at room temperature with the presence of sodium ion, whereas, in the presence of potassium ion, it could be in both coil or helix state depending on the temperature and salt concentration. This further indicates that in the presence of potassium ion, the gel-forming ability and strength are higher, and hence in ***Table 2.*** the utilization of sodium citrate was removed on the third trial and shifted to potassium citrate instead for a more favorable texture.

As can be seen from ***Table 2.***, the weight of maltodextrin used in making the fruity pre-mix jelly was higher than the ones in the chocolate pre-mix. The cocoa powder that was used in the chocolate variants significantly affected the jelly as it was able to increase flavor acceptance and give a desirable textural body to the final product (Suriwong et al., 2025). Therefore, to replace the absence of this cocoa powder functionality in the fruity pre-mix, maltodextrin concentration was further increased. Maltodextrin is known to be a low-sweet saccharide polymer of D-glucose linked through α-1,4 bonds and branches of α-1,6 bonds, that is considered a good source of energy, soluble in water, and has a gelling control, hence making it a suitable filler for the pre-mix jelly formulation that replaces the absence of cocoa powder (Arnold & Chassaing, 2019).

**Flavor**

For the final mango flavor selection, the author chose mango A instead of mango B for the mango flavor jelly. The mango A flavor has the addition of acetic acid, which is an organic compound

containing a carboxylic acid group, that is known to impart the least sour taste and flavor in comparison to other organic acids (Farma et al., 2024). In addition to that, the presence of linalool in the mixture further boosts the tropical aromas that are imparted, which explains the slightly green and sulphuric note that is exerted from the flavor powder (Chigo-Hernandez & Tomasio, 2023). Hence for the mango flavor, a slightly higher concentration of citric acid was used in comparison to the chocolate pre-mix in ***Table 1.*** because the chosen mango flavor has a more acidic note and at the same time, citric acid could boost the sour flavor in with the presence of hydrogen ions in it (Neta et al., 2007). This also applies to the jelly with strawberry flavor, as generally it is known that strawberries exert an acidic and sour flavor (Andersen et al., 2023).

Whereas for jelly with taro flavor, there is a decrease in the concentration used as shown in ***Table 2.*** on trials 3 and 4. Taro is known to have caramelly, roast, milky, green, nutty, vegetative, and fruity notes, which similar to other tubers that are grown in soil, also exhibit an earthy note (Aboubakar et al., 2009; Zhu et al., 2015). Therefore, the vanilla flavor is added as a combination as vanilla could help in adding creaminess, balancing sweetness as well as masking bitterness and acidity in culinary products (Vijayalakshmi et al., 2019). In which the earthiness and bitterness of the taro flavor could be masked with the addition of vanilla flavor to boost the sweetness.

### 3.4. Conclusion and Recommendation

In conclusion, the incorporation of both potassium citrate and citrate does affect or give desirable changes to the textural properties of the final jelly product, where the addition of both at an appropriate concentration would yield textural properties similar to the ones found commercially in the market. Not only that, it resulted in the proper and desired formulations for the jelly made with the carrageenan base given by the customer to be achieved.

Nevertheless, due to time constraints and panelist limitations on the fast-paced projects, the research could not be done thoroughly hence less accurate and reliable data was used to determine the product reformulation. Moreover, for future research, .

# SELF REFLECTION

During the internship, the author has practiced and learned her hard and soft skills, one of which the most important is critical thinking which is used when a problem is faced during the project and should be responded to and solved quickly. Communication skills between the team members are also essential to lessen the mistakes and misunderstandings during the project, in which the author has gained experience from the previous organizational committee when studying at the university. Nonetheless, organizational skills are also very crucial when coming to the professional field, as there are lots of fast-paced projects with packed deadlines due to the samples needed for customers' submission, hence the time management skills are tested and needed here.

Despite all that, the working environment in Xumei is very comfortable, and all of the staff as well as interns are very friendly and helpful in adjusting to the new environment as well as working as a team. As the author was conducting intern in a flavor house, she also got a more in-depth understanding of flavor chemistry and technology which was further sharpened during her time in the company, where several theoretical knowledge could be applied here. Eventhough several mistakes were made during the internship period, it served as a learning process for the author to be more cautious in the future. There is no overtime with regards to the working schedule, thus the urgent projects would be done throughout the day and communicated with the respective departments as well. Regularly, the working hours should be 9 hours with a 1-hour lunch break, and when the projects are packed, it would be organized throughout the day on what will be done and the day still closes at 5.00 p.m. every day.

Regardless of the soft skills, the author also learned a lot of lab skills that have been taught throughout her learning journey as a student in i3L. However, there are still some differences with regard to the working field, such as the use of chemicals that are unfamiliar for the flavor creation. Even though it was theoretically far different, the practical work gave hands-on work directly for the flavor creation and application that familiarized the author with the chemicals directly and also certain equipment such as autoclave and homogenizers. Additionally, the BRIGHT sessions and

power talks provided by i3L give insight into modern technology that aligns with the author's learning interest, which was also supported by the recent laboratory technology that has been used throughout the learning journey.

The theoretical knowledge learned throughout the author's journey as a student has been highly effective in the application during the hands-on experiment as well as in solving problems when conducting trials. With that, the author's impact on the workplace provides help to the research and development team with their ongoing projects on improving and developing new flavors or the creation of prototypes. Furthermore, the author's ability to understand Chinese eases the sales and marketing along with the research and development team with their Chinese-related documents, translation as well as communication with the clients. The author's initiative and independence in the workplace also has contributed much to the completion of projects that are given.

# CONCLUSION & RECOMMENDATION

## 5.1. Conclusion

The internship experience serves as a stepping stone for the author's learning process in the working field. The lectures learned during the author's university year have equipped her to be ready for the working field, hence the author was able to apply the theoretical knowledge learned into a practical application while at the same time acquiring extensive knowledge that has not been covered during the educational study. Both hard and soft skills as well as critical thinking skills were further sharpened and trained during the internship period which prepares the author for the next step of the journey after graduation.

## 5.2. Recommendation

There is still vast knowledge to be learned during the internship, the internship report was just a small part that represents what the author do and has learned throughout her journey in the company. For future internship experience, it is suggested that the internship be completed before the report submission so that the schedule is not so packed with doing the report while conducting the internship at the same time. Furthermore, having a complete project instead of an ongoing one and collecting proper data for more accurate results might be highly suggested.

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# APPENDICES

***Appendix 1.*** *Hedonic test forms*

**Hedonic Test**

Name : Product :

Date : Concept :

Taste the sample and give it a score from 1 to 9 based on your liking. (Score 1 dislike extremely - 9 like extremely)

| Parameter | Appearance | Aroma | Texture | Taste | Overall |
|---|---|---|---|---|---|
| Score | | | | | |
| Comment | | | | | |

***Appendix 2.*** Turnitin plagiarism results