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ENRICHMENT PROGRAM REPORT

THE DEVELOPMENT OF KIMCHI SEASONING POWDER BASED ON THE POWDER FLOWABILITY AND SENSORIAL PROPERTIES WITH THE APPLICATION OF NETT-BASED SNACK

STUDY PROGRAM
Food Technology

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INTERNSHIP REPORT

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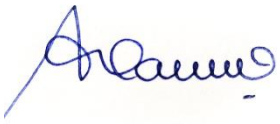

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We hereby declare that this final thesis project is from student's own work. The final project/thesis has been read and presented to i3L's Examination Committee. The final project/thesis has been found to be satisfactory and accepted as part of the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

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ABSTRACT

Food seasoning powder which are used as and/or within food products should have free-flowing properties. Powder caking is one of the adverse effects of seasoning powder with poor free-flowing properties. A solution to prevent powder caking is by improving the composition of the seasoning powder. It can be achieved by substituting the liquid-based to powder-based ingredients and/or utilization of anti-caking agent (e.g. silicon dioxide (SiO_2)). Therefore, this study aimed to evaluate the impact of powder-based capsicum ingredient and SiO_2 on the flowability of kimchi seasoning powder as well as to obtain the closest sensorial properties of samples compared to the approved seasoning powder. The development of kimchi seasoning powder was done at PT Indesso Culinaroma Internasional. Two trial and control samples of kimchi seasoning powder were analyzed for the flowability properties by Hausner Ratio (HR) and Angle of Repose (AOR) as well as the sensory evaluation by performing triangle tests. The results of HR values were analyzed using Kruskal-wallis Test, while the results of the sensory analysis were further analyzed using the Chi-square Distribution Test. This study found that the substitution of liquid-based to powder-based ingredient (T1) had insignificant lower HR to (1.5420; P>.05) and AOR (51.32°) compared to the control sample which indicated that the free-flowability was improved. In addition, the combination of ingredient substitution and utilization of SiO_2 samples (T2) had the lowest HR (1.5079; P>.05) and AOR (50.65°) which also indicating the improvement of free-flowability. Based on the sensory evaluation, only 37.5% and 32.5% of panelists were able to answer correctly on T1 and T2 triangle tests, respectively. Both reformulated samples had no significance difference with the control samples. It can be concluded that the combination of ingredient substitution and utilization of anti-caking agent was more effective to improve the free-flowability.

Keywords: *Kimchi Seasoning Powder, Free-flow, Powder Caking, Hausner Ratio, Angle of Repose*

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AOR	Angle of Repose
HR	Hausner Ratio

CHAPTER I: INTRODUCTION

This chapter mainly reviewed about the company where the author was having an internship at. The company profile was discussed briefly, which was followed by the vision and mission of the company. The main activities as well as the organizational structure of the company was also elaborated in this chapter.

1.1 Company Profile

Indesso (Indonesian Essential Oils) was founded by Robertus Hartanto Gunawan in Baturraden, Purwokerto, Central Java in 1968. Originally, the main activity of Indesso was to produce clove leaf oil and other Indonesian essential oils by using a distillation method and distributing them for the Indonesian market. Over the years, Indesso enlarged their product portfolios to essential oils (e.g. nutmeg and citronella oil, etc.) and botanical extracts (e.g. cocoa, coffee, tea, vanilla, ginger, red ginger, turmeric, etc.). In 2001, the plant and warehouse of Indesso in Cileungsi, West Java was officially functioning.

Indesso entered the Seasonings and Savory Ingredients segment through Culinaroma which was spinned-off as an independent entity PT Indesso Culinaroma Internasional in 2016. Other than this segment, Indesso also has several segments as independent entities in Indonesia, they are: PT Indesso Aroma, PT Indesso Niagatama, PT Indesso Primatama, and PT Indesso Sanavia Internasional. Furthermore, Indesso has extended their location to Singapore, Malaysia, and Tanzania. The golden jubilee of Indesso was celebrated in 2018 and was marked by the launching of a new logo which can be seen in **Figure 1.**

Figure 1. New logo of Indesso

1.2 Company's Vision and Mission

Indesso has the vision to be a regional leader in ingredients for the food, flavor and fragrance industry through innovation, efficiency, and sustainable business practices. The mission of Indesso is to create innovative solutions with sustainable natural-based ingredients for life.

1.3 Company's Main Activity

PT Indesso Culinaroma Internasional focuses on the development and production of halal seasonings and savory ingredients, particularly for snack and non-snack food manufacturers before finished products are sold widely to the consumers. This company offers the products in the form of powder, sauces, as well as paste for the manufacturers. Other than that, Indesso is also the distributor of world-leading companies for Indonesian market, such as Firmenich flavors and perfumery, Ballantyne cheese powders, Nexira hydrocolloid (acacia gums), PureCircle natural sweeteners (stevia),

Ottera natural colors, Martin Bauer natural extracts, Döhler juices and purees, Tastecraft syrups, Biospringer yeast extracts, as well as Solutex omega3/EPA/DHA. Indesso has served many customers and exported their products to over 40 countries around the world, including USA, Canada, UK, Netherland, India, Hong Kong, China, Singapore, Malaysia, and Australia.

1.4 Company's Organizational Structure

PT Indesso Culinaroma International involves several departments, which are the Sales & Marketing Food Ingredient, Innovation & Application (Savory), Operations Savory, Quality Assurance Savory, Supply Chain Savory, as well as Finance & Accounting as seen in **Figure 2**. The Sales & Marketing Food Ingredient are based in Jakarta, meanwhile the other departments are based in Cileungsi. The Sales & Marketing Food Ingredients are responsible to promote Indesso to the markets particularly the Food and Beverage companies in order to acquire customers in nation- and international-wide. When there are clients that quests for savory food ingredients, the Sales & Marketing team will send the requests to Product Development Department.

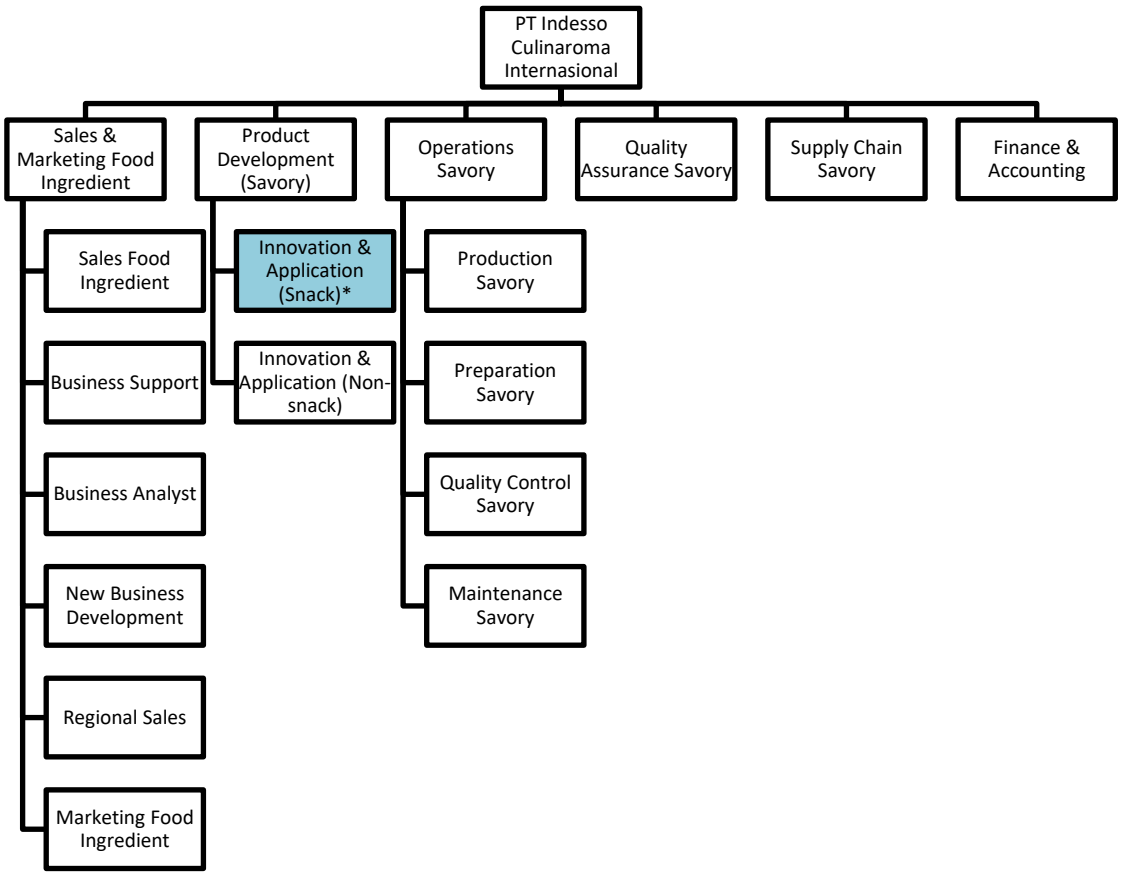


Figure 2. Organizational Structure of PT Indesso Culinaroma Internasional.
*The internship was in the unit of Innovation and Application (Snack)

In the Product Development Department, the clients' requests will be distributed to the corresponding division, which are the snack and non-snack division. The requests to innovate Food Ingredient for snack bases are completed by the Innovation & Application (Snack) division in which this is the unit where the internship is held. The innovation was done by the employees, meanwhile the application was completed by the author. Meanwhile, for the Innovation & Application (Non-

snack) division, they are obliged to complete the requests to innovate Food Ingredients for non-snack bases, e.g. sauces, paste, seasonings for noodle and paste, processed meats, and others. During the progress, this department works closely with the Sales & Marketing team to evaluate the trials' in terms of sensory profile as well as Quality Control unit to check the relevant physicochemical properties (e.g. pH, salt content, moisture content, color analysis, flowability properties, viscosity, and others).

Once the client has approved the trials, the products are then produced in industrial-scale which are done by the Operations Savory Department. The products' formula from the Product Development Department are sent Operations department. The production line and the end-products will be checked regularly by the Quality Control team. The Quality Assurance Savory Department are responsible for setting quality standards in order to ensure that the production is maintained at such standards as well as compliance to the policies and regulations. Meanwhile, the Supply Chain Savory Department are obliged to manage daily operations that are related to the clients' satisfaction in order to ensure that the clients' receive the best service from PT Indesso Culinaroma Internasional. On the other hand, the Finance and Accounting Department are responsible to manage the funds in the company.

CHAPTER 2 : INTERNSHIP ACTIVITIES

During internship from August 1, 2022 until January 31, 2023, the author should work under certain conditions that had been determined by the company. There were several internship tasks that were done during this internship, including projects. These matters would be discussed in-detailed in this chapter. Furthermore, the practices at the company were compared with the learning during in i3L. In addition, there were difficulties that were encountered during internship which would be elaborated with the solutions to overcome.

2.1 Working Conditions

The office hour for the employees at PT Indesso Culinaroma Internasional started at 8.00 a.m to 5 p.m and it was a full Work From Office system. The lunch period was at 12 p.m to 1 p.m. There was only 1 shift for the Department of Product Development. The employees were allowed to do overtime working as needed, either working after 5 p.m or working at weekends. Similar to the employees, the working schedule for internees were the same with the employees without an overtime period for internees. The internees were also asked to come to the office on weekdays. This working conditions were considered regular and acceptable in the working environment. At least once a month in the morning, a meeting was held in the office by gathering the manager with all of the supervisors, operators, as well as the internees. The meeting took 30 minutes to 1 hour. Commonly, the meeting was held to discuss any relevant urgent problems that should be resolved by the forum. For instance, a meeting to remind all of the employees about the core values of Indesso that should had been applied in daily basis at the office. Other than that, the discussion forum also could be used to discuss about the schedule and the people who were in charged to deliver products to the package courier every day.

During working, a clean working habit became the priority, since the employees were handling food products. The employees that were in charged to make the seasoning powder were obliged to use the Personal Protective Equipment (PPE), including lab coat, shoe cover, hair cap, and gloves. All food ingredients should be kept tightly in the proper packaging (e.g. jar, glass bottles, and aluminum foil packaging) in the shelf, cupboard, or refrigerator. All tools that were used should be clean from any food and environmental contamination. At the end of the day, every employees were obliged to clean their workplace as well as shut down every equipment (e.g. analytical balance, hotplate, microwave, printer, etc.) from the electrical sources prior to going home.

2.2 Internship Tasks

Having an internship opportunity in the unit of Innovation & Application (Snack) of Product Development Department, there were several tasks that should be completed, which consisted of the daily activities, main project, as well as other project that was on development. The internship activities that were done was depicted in **Figure 3**. This section discussed clearly about the daily activities and other project that was done during the internship.

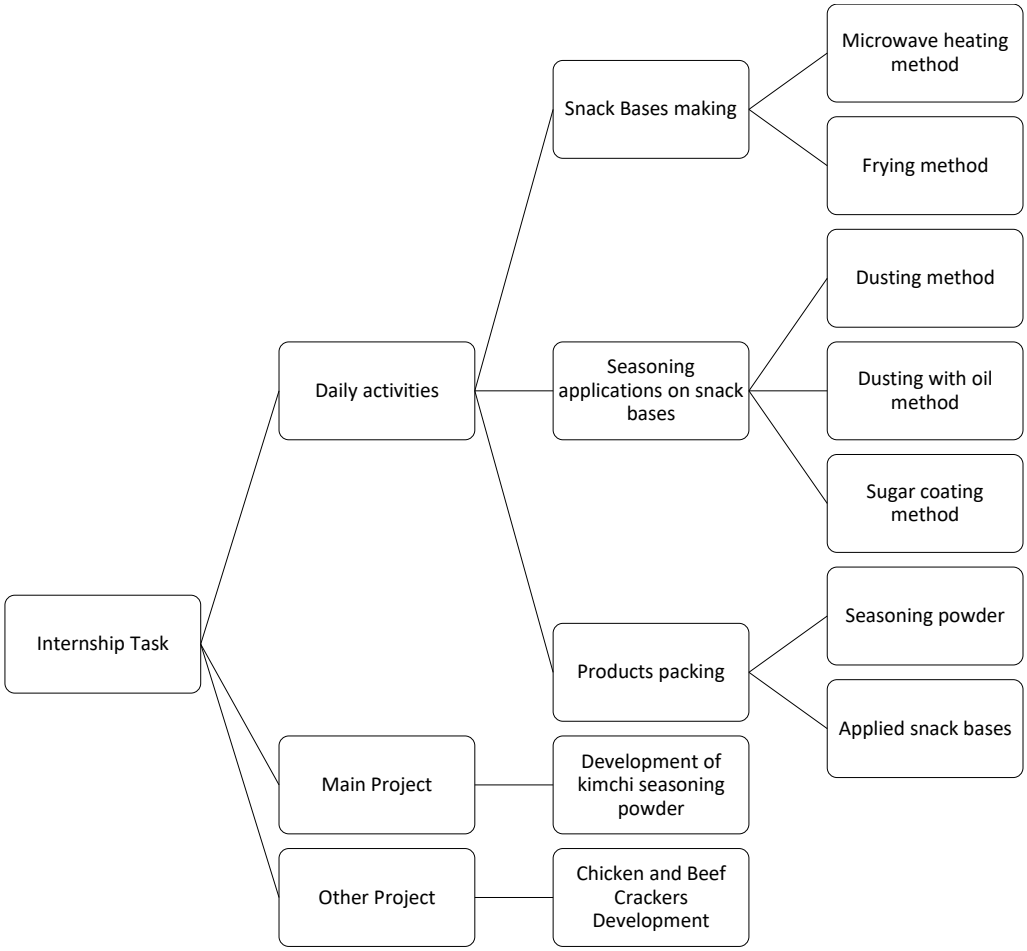


Figure 3. Internship Tasks.

2.2.1 Daily Activities

There was a possibility that several activities should be completed in a day. Although there were many seasoning powders that should be applied onto various snack bases, but the main principle of the application remained the same. This section discussed clearly about the daily activities during internship, which included the seasoning applications on snack bases, snack bases making, and products packing

2.2.1.1 Snack Bases Making

Most of the snack bases have been given by the clients for the application purposes. Nevertheless, some clients may not send any snack base for application. Therefore, Indesso should make the corresponding snack base to proceed with the workings. Upon requests, the author was asked to make the snack base, e.g. making popcorn base, nett base, and fried macaroni base. The popcorn base was made by popping corn kernels using a microwave. Meanwhile, the nett base was made by deep-frying the raw nett base. The nett base making was quite tricky because the conventional deep-frying caused the snack base to be oily. After frying, the nett base was dried by using kitchen towels and a deoiling machine to remove excessive oil. Therefore, the nett base should be directly used for application and kept in a sealed aluminum pouch to prevent rancidity. Other than that, frying macaroni pellet was tricky because it required some trials to determine the suitable oil

temperature and frying techniques. The crispy and less-oily fried macaroni was able to be produced at 200^{o}C.

2.2.1.2 Seasoning Applications on Snack Bases

Almost every day, the author was dealing with various snack base applications using numerous seasoning powder. The author learned how to apply the seasoning powder evenly on different snack bases. Each snack base has different characters which affect its tendency to be attracted to the seasoning powder. In general, the desirable snack base for application would be slightly oily and crispy. An excessive amount of oil is not desirable, since it will cause rancidity on the snack base. Similarly, each seasoning powder has different properties which affects its ability to interact with the snack base when being applied.

Therefore, PT Indesso Culinaroma Internasional has several methods to apply seasoning powder onto the snack base in order to induce the optimum flavor on the snack base. For the snack bases that are slightly oily (e.g. flat potato chips, wavy potato chips, potato crisps, sweet potato chips, tempe chips, and cassava chips), after reheating to increase its crispiness, the application using dusting method is suitable to be applied. The dusting method is done by spreading the seasoning powder gradually and evenly onto the crispy snack base while being shaken. Meanwhile, for the snack bases that are not oily (e.g. rice crackers, extruded bases, tortilla chips, and coated peanut snack), the application is done by adding some vegetable oil onto the base prior to dusting the seasoning powder. Nevertheless, the addition of the vegetable oil was quite tricky, since an excessive amount of oil would induce rancidity on the snack base. Therefore, the amount of oil added onto the base should be measured. Other than that, for the seasoning powder that is quite sweet (e.g. caramel flavor, chocolate flavor, fruity flavor, etc.), the sugar coating method is suitable to be applied onto the snack base, since it will cause the flavor to be tastier on the snack base.

2.2.1.3 Products Packing

The author was also assigned to pack the seasoning powder for the clients. The snack application results as well as the seasoning samples are then sent to the clients and the marketing department. The author learned to pack the snack application results and seasoning powder properly in which every product should be kept in a sealed aluminum pouch to avoid any environmental damage (e.g. sunlight exposure as well as air and water contaminations). Moreover, every product that is sent outside the office should be recorded in-detailed for tracking purposes.

2.2.2 Main Project

Occasionally, the clients of PT Indesso Culinaroma Internasional sent another comments or complaints after they received the seasoning powder in the production-scale. One of which was that a client complaint that their kimchi seasoning powder that they bought from PT Indesso Culinaroma Internasional had a poor flowability properties which causing caking and lumpy powder when being sprayed through the nozzles in the production line. Therefore, the formulation of the kimchi seasoning powder should be improved, while preserving the current flavor profile. In this project, the author was assigned to analyze the flowability properties of the kimchi seasoning powder and conducting sensory test. This project will be discussed further in **Chapter 3**.

2.2.3 Other Project

The author was assigned to develop a new snack base, particularly chicken and beef crackers by using chicken and beef premix made by PT Indesso Culinaroma Internasional. This project aimed to find the formula to make the chicken and beef crackers as well as the suitable method to make the crackers. The developed crackers should be similar in appearance to a market product, Entree Crispy Pork which could be seen in **Figure 4b**. The ingredients that were needed to make this product consisted of 3 materials, which were the chicken or beef premix, tapioca flour, and water. The formula of the chicken and beef premix had been settled. There has been already the prototype formula to make the chicken and beef crackers. Nevertheless, the prototype formulas were not suitable for these chicken and beef premix. This was due to the fact that each premix had different ingredients and ratio. It affected its ability and performance to interact with other materials (tapioca flour and water). Therefore, the ratio of the premix, tapioca flour, and water needed to be adjusted.

(a) (b)

Figure 4. (a) Packaging of Entree Crispy Pork; **(b)** Product view of Entree Crispy Pork.

Many trials had been conducted to successfully make the crackers. It was a challenge to find the suitable ratio of the premix, tapioca flour, and water. Other than that, the methods that were used in the making were also affecting the end-products. The beef crackers had been able to be made similar to the market product although there had no comments from the clients yet. Meanwhile, the development of the chicken crackers were still in progress. The formula to make the beef crackers was shown in **Table 1.** The beef crackers were made by mixing the Culinaroma Beef Premix with water and tapioca flour subsequently. The dough was then placed in a plastic and run through a pasta maker using the width of No. 9. The batter was then steamed for 50 minutes to semi-solidify the batter. Then, the dough was cut into pieces of 1.5 cm x 1.5 cm and oven to dry at 60°C for 90 minutes. The results were called as the raw beef crackers and its moisture content was checked for sampling. The desirable moisture content of the raw beef crackers were around 0.6-0.8%. Otherwise, the beef crackers would not crispy or not expand at all when being fried. In order to fry the raw beef crackers, a deep-frying method was used using vegetable oil. It was fried at 180°C for approximately 5 seconds.

Table 1. Beef crackers formula

Ingredients	Amount (gram)
Culinaroma Beef Premix	29
Water	38
Tapioca Flour	33
Total	**100**

2.3 Comparison between Theory and Practices during Internship

Everything that the author had learnt at the university was really helpful to increase the knowledge in food and beverage. Therefore, the author already had some preparations with the knowledge during the internship at PT. Indesso Culinaroma Internasional. Nevertheless in the practices at the company particularly in the Department of Product Development in the unit of Innovation and Application (Snack), only parts of the theory that have been learned was related closely to the main activities. They affect in the ingredients determination during formulation. With the profound knowledge, it was easier to correlate the principles with the applications as well as to have a discussion with the employees. Some of the comparison were as follows:

1. Physicochemical characteristics of seasoning powder
    a. Moisture content. As had been taught during the classes, the moisture content was also checked by using rapid moisture analyzer in order to observe the moisture content of seasoning powder whether it had achieve to the desirable range or not,
    b. Salt content. The ingredients as well as the seasoning powder were frequently checked for their salt content in order to ensure that the salt content was still in an acceptable range, since many constituents of the savory seasoning powder were high in salt. Meanwhile, few laboratory experiences in the university required salt content measurement.
    c. Flowability. In the university, the flowability of powder was introduced to be checked by using Hausner Ratio method. Meanwhile in PT Indesso Culinaroma Internasional, the flowability of powder was checked more advance by using HR and AOR.
2. Sensorial properties of seasoning powder
   The sensorial analysis that had been taught in the classes was classified into many method. However in the practices, the sensorial analysis was done mostly by using descriptive analysis by combining several method at once, including free choice profiling, time intensity method, Temporal Dominance Sensation (TDS) method, and texture profile. Furthermore, since the sensorial analysis was done by trained panelists, the statistical analysis was not used in developing the seasoning powder.

2.4 Difficulties during Internship and the Solutions

Sometimes, there were some difficulties that was encountered during the internship. The difficulties may be due to the client requests in the innovation and/or the technicalities in the applications. The most common difficulties was about the suitable method to do application on certain snack bases in order to make the seasoning powder was flavorful on the snack bases. For instance, many trials should be done to determine the suitable oven temperature for the application of malkist base. The sugar coating on the malkist base should be melted prior to the addition of seasoning powder on the malkist base, therefore, the seasoning powder able to adhere onto the malkist base. The sugar can be melted by pre-heating the malkist base at 130^{o}C with upper heat for approximately 20-30 minutes with rotation every 15 minutes. Lower temperature would not melt the sugar, whereas, higher temperature would cause uneven caramelization and burn the crackers. Other than that, once the seasoning powder had been applied on the malkist base, it was re-heated at 120^{o}C with upper heat for approximately 30-60 minutes with rotation every 15 minutes. The tray of malkist base should be placed on the lower part of the oven. Otherwise, the seasoning powder would be burnt which was shown by the dark spots of the seasoning powder. Furthermore, the rotation timing also affected the heating process. Too many rotation within the baking process (e.g. rotation for every 5-10 minutes)

causing the temperature to be lowered and unstable, thus, it would require longer time to melt the sugar coating as well as to adhere the seasoning powder onto the malkist base. Nevertheless, each seasoning powder comprises of different ingredients with different melting points. Therefore, the baking period of the malkist base were varied and should be checked regularly.

Some of the difficulties were due to the inability to do the task well. Nevertheless, the employees always been able to overcome those difficulties and help the author in improving the skills in the unit of Innovation and Application (Snack). The author was struggling to do the dusting method in order to produce an evenly-spread seasoning powder onto the snack base. The difficulty was that the seasoning powder was not spread evenly onto the snack base which was easily seen by the spots of the powder. However, with the guidance and patience of the employees, the author was getting better in doing the dusting method.

CHAPTER 3: PROJECT

An in-depth discussion of the main project at PT Indesso Culinaroma Internasional was discussed in this chapter. It defined truly about the background and description of the project and methods to do the project. The results were elucidated along with their elaboration in discussions. Subsequently, the conclusion of the project and recommendations for further studies were also disclosed.

3.1 Project Description

A detailed description of the main project was discussed in this section. This included the background of conducting the project, methodology, results and discussions, as well as conclusion of the project and recommendation for further studies related to the similar topics.

3.1.1 Project Background

The project background section included the literature reviews that were related to the project and scopes of the project. The objectives of the project were also determined to set goals that had to be achieved in this project. The importance of conducting the project was also defined, and lastly, the problem formulation and proposed solution were elaborated in this section as well.

3.1.1.1 Food Powder

Food seasoning powder refers to the particulate mixture of several compounds used as and/or within food products which has the function to improve the flavor profile of Ready-to-Eat (RTE) food to which they are applied (Micha, 2011). Generally, dried seasonings has low tendency for spoiling due to its low moisture content and water activity as well as high salt content which are not the favorable conditions for the microbial growth. Nevertheless, seasoning powder should have certain physical properties, since it will affect during the food processing, handling, as well as packaging. Most importantly, the seasoning powder should have free-flowing properties during the manufacturing process. Flowability is the property of granular solid materials and powders to move when the bulk material is moving by force or gravity (Schlick-Hasper et al., 2022). It is the result of the combination of the several factors, including the physical properties of the material (e.g. particle size and particle shape), external conditions (e.g. humidity), as well as the equipment used to handle, store, and process the material (Abdullah et al., 2010). Furthermore, the seasoning powder should have stable sensorial properties that are able to withstand the processing from the production, storage, to distribution until the food is consumed by the consumers (Schlick-Hasper et al., 2022; Tahmaz et al., 2022).

3.1.1.2 Food Powder Caking

One of the difficulties in developing seasoning powder is its susceptibility to cake and form lumps during processing and storage. The most common causes of caking powder is due to the poor flowability of powder which caused by the absorption or migration of the moisture from the environment into the seasoning powder (Freeman et al., 2015; Prime et al., 2011). The mechanism of caking formation involves four steps, which are bridging, agglomeration, compaction, and liquefaction, subsequently. Initially, the food powder will undergo bridging in which it is transformed into lumps due to the surface deformation and sticking among particles. Subsequently, powder

agglomeration will occur in which causing the particles to clump with structural integrity in bigger size (Juliano & Barbosa-Cánovas, 2010). These clumps causing a compaction to occur which leads to the reduction of free spaces among particles and minimum free-flowability. Lastly, liquefaction will occur in the presence of high moisture which causes the disappearance of interparticle bridges and solubility of low molecular weight matters, hence, the caking powder will act similarly to a liquid (Juliano & Barbosa-Cánovas, 2010). This caking powder reduces the quality and ability of powder to pass through the production line. This will lower the production efficiency as well as the results in the end-products (Freeman et al., 2015; Prime et al., 2011).

3.1.1.3 Factors affecting Free-flowability of Food Powder

The free-flowability of seasoning powder is influenced by its particle properties and powder properties. The particle properties includes the type of ingredients used in the formulation, density, particle size and shape, as well as moisture. Smaller particle size provides lower flowability, since smaller particle size has a greater surface area to interact among particles as well as greater friction forces that inhibits the powder flow. These particle properties are mainly affected by intrinsic factors of powder, including temperature, relative humidity, compaction level, agglomeration, segregation, and anti-caking agents (Juliano & Barbosa-Cánovas, 2010; Yapici et al., 2020).

On the other hand, the powder properties that affect its free-flowability includes the bulk density, size distribution, and cohesiveness. These powder properties are mainly affected by external factors, e.g. feeding rate, vibration, and hopper dimensions and designs in the manufacture (Juliano & Barbosa-Cánovas, 2010).

3.1.1.4 Solutions to Prevent Caking

3.1.1.4.1 Substitution of Liquid-based to Powder-based Ingredients

One of the solutions to overcome the caking problem is by improving the composition of the seasoning powder to hinder the caking problems (Lipasek et al., 2012). Therefore, the seasoning powder should be reformulated which can be done by reducing the usage of liquid ingredients, substituting the ingredients, incorporating anti-caking agents, and others. Reducing the utilization of liquid ingredients and substituting it to powder-based ingredients are beneficial to lower the moisture content of the seasoning powder (Lipasek et al., 2012; Pui et al., 2020).

3.1.1.4.2 Utilization of Anti-caking Agent

An anti-caking agent is useful as the moisture-protective barrier on the surface of hygroscopic particles. The anti-caking agent will compete with the host powder to bind with the environmental moisture. Thereby prevents caking, lumping, or aggregation of powder and promotes the reduction in moisture migration through the gradient of water activity. It improves the free-flowability of the seasoning powder (Juliano & Barbosa-Cánovas, 2010; Lipasek et al., 2012; Pui et al., 2020). In the reformulation process, an anti-caking agent can be utilized into the seasoning powder. It is known as the food additive that provides and maintain the stable flow of powder by reducing the cohesiveness and compressibility of interparticle forces (Juliano & Barbosa-Cánovas, 2010). Commonly, anti-caking agent is in the form of very fine powders approximately 40–100 µm. The most common types of anti-caking agent are silicates, polysaccharides, phosphates, and stearates. In this project, the silicate will be used in the reformulation of seasoning powder. They are partially soluble or insoluble in water and

ethanol. They have a high surface which enabling to absorb significant amount of moisture, thus, preventing the formation of lumps in the powders (Yapici et al., 2020).

One of the silicates is the silicon dioxide (SiO_2) which also known as Silica that is composed of silicon and oxygen. It has a transparent to opaque, crystalline, odorless, or an amorphous solid. It has the ability to maintain the physical stability of the host powder by preventing surface deformation and inhibiting the formation of interparticle bridges which become the causes of lumpy powders (Addo et al., 2020; Juliano & Barbosa-Cánovas, 2010; Lipasek et al., 2011). Therefore, SiO_2 is widely utilized as an anti-caking agent and commonly added in small amount approximately 0.5% to 2% in powder formulations (Juliano & Barbosa-Cánovas, 2010).

3.1.2 Scope of the Project

This project focused on the flowability and sensorial analysis of the reformulated kimchi seasoning powder and comparing with the control kimchi seasoning powder which covered:

a. Making the reformulated and control kimchi seasoning powder in lab-scale,
b. Conducting and analyzing flowability analysis using Hausner Ratio (HR) and Angle of Repose (AOR) method,
c. Conducting and analyzing sensory test using triangle test method.

3.1.3 Objectives

The objectives of this study were:

1. To evaluate the impact of powder-based capsicum ingredient and SiO_2 on the flowability of kimchi seasoning powder.
2. To obtain the closest sensorial properties of samples compared to the approved seasoning powder.

3.1.4 Importance of Project

The importance of this project to complete the development of kimchi seasoning powder as desired by the client, including its flavor profile and its characteristics in the manufacturing process. Other than that, this project provided the flowability and sensorial analysis of the reformulated kimchi seasoning powder and their comparison with the control kimchi seasoning powder in order to observe the significance of the reformulation of kimchi seasoning powder.

3.1.5 Problem Formulation and Proposed Solution

PT Indesso Culinaroma Internasional had made a kimchi seasoning powder as requested by a client. Although the client had agreed with its flavor profile, they complained that the seasoning powder had poor flowability when they tried to apply the seasoning powder in their production line. This caused troubles in its ability to pass through the nozzle in the manufacturing process. Therefore, the Product Development team was asked to rework the formulation of the kimchi seasoning powder to improve the flowability properties, while maintaining the flavor profile of the current kimchi seasoning powder. The proposed solution to the aforementioned problem was by reformulating the kimchi seasoning powder by substituting the ingredients and adding anti-caking agent into the seasoning powder. Substituting the liquid ingredients to powder-based ingredients could be done, since the usage of liquid ingredient would increase the moisture content of the seasoning powder. Other than that, another trial to incorporate anti-caking agent into the seasoning powder could be done to improve the free flowability of the powder.

After the aging period of the reformulated kimchi seasoning powder, the flowability analysis and sensorial analysis could be conducted in order to evaluate the reformulation in comparison to the control kimchi seasoning powder. The flowability analysis was done by analyzing the HR and AOR. The flowability properties of the reformulated seasoning powder should be improving compared to the control. In addition to its simplicity and accuracy of measurement, these analysis were feasible to be done in the office, since the Quality Control Division had the equipment for the analysis. Meanwhile, the sensorial analysis was done by using triangle test method, since it was the suitable method to evaluate whether the reformulated kimchi seasoning powder were distinguishable or not when compared to the control. The reformulated kimchi seasoning powder should not be distinguishable with the control which indicated that the reformulated seasoning had comparable flavor profile with the control.

3.2 Methodology

The development of kimchi seasoning powder can be seen in **Figure 5**. It was started by determining the reformulation of kimchi seasoning powder which was done by the developer. Further procedures were done by the author, starting from the seasoning powder making until the data analysis and evaluation. The seasoning powder was then made based on the formula of the reformulated samples. When the seasoning powder had been made, it was rested for overnight in order to let the aging process occurred. Then, the free flowability properties were analyzed using HR and AOR. Subsequently, the sensorial properties were analyzed by conducting triangle test. All of the data was analyzed and evaluated.

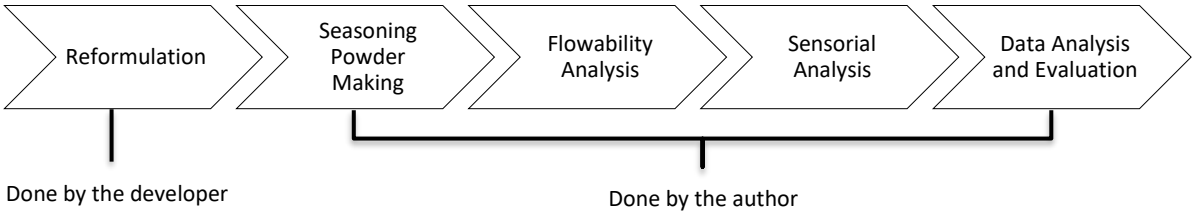


Figure 5. Flowchart for the development of reformulated kimchi seasoning powder.

3.2.1 Kimchi Seasoning Powder Making

The kimchi seasoning powder was made by mixing several ingredients in which its amount had been determined by the developer (employee). There were 3 types of samples that were made for this project, which were the control, T1, and T2 samples as seen in **Table 2**. The control sample was the original kimchi seasoning powder that should be reformulated which contained premix and a liquid-based capsicum oleoresin and without any addition of powder-based encapsulated capsicum oleoresin and silicon dioxide (SiO_2). Meanwhile, the T1 sample contained premix and powder-based encapsulated capsicum oleoresin. On the other hand, the T2 sample contained premix, powder-based encapsulated capsicum oleoresin powder, and SiO_2 which acted as the anti-caking agent. The powder-based encapsulated capsicum oleoresin that was added into T1 and T2 were equal in dosage. The powder was then blended by using a blender and sieved by using a sieve in order to obtain a homogenous mixture. The seasoning powder was then rested at room temperature overnight for aging to improve its flavor characteristics. The seasoning powder was kept in plastic and sealed in an aluminum pouch for storage.

Table 2. Formulation Differences among Samples.

Ingredient	Sample		
	Control	T1	T2
Premix	✓	✓	✓
Liquid-based Capsicum	✓	-	-
Powder-based Capsicum	-	✓	✓
SiO_2	-	-	✓

3.2.2 Flowability Analysis

The flowability properties of the kimchi seasoning powder were analyzed using bulk density (HR) and AOR. The HR provided the compaction test of food powder which mimicked the density changes during handling and distributions (Juliano & Barbosa-Cánovas, 2010). The bulk density was determined by particle density, which measured the loose bulk density and compact density using the standard protocol from PT Indesso Culinaroma Internasional. The loose bulk density was measured by freely pouring the seasoning powder into a 100-mL measuring cylinder (**Appendix 1**) until the 20-mL mark was reached. The net weight of the powder was measured by using an analytical balance (**Appendix 2**). The compact density was then measured by subjecting tapping force onto the seasoning powder in the 100-mL measuring cylinder. The seasoning powder was then added until it reached the 20-mL mark while continuously being tapped. Subsequently, the net weight of the powder was measured. The data sampling was taken in triplicate and averaged for each type of samples.

The HR was defined as the ratio of a powder's compact density to its loose bulk density (Moravkar et al., 2020). The HR was obtained by dividing the net powder weight of the compact density to the net powder weight of the loose bulk density. The values HR indicated a certain flow property which can be seen in **Table 3** (Moravkar et al., 2020). Nevertheless, the flowability properties could not be evaluated from its HR solely, since it was affected by various variables in the system (Juliano & Barbosa-Cánovas, 2010).

$$HR = \frac{Weight\ of\ Compact\ Density\ (g)}{Weight\ of\ Loose\ Density\ (g)}$$

Table 3. Corresponding HR and flow properties

HR	Flow Properties
1.00 - 1.11	Excellent
1.12 - 1.18	Good
1.19 - 1.25	Fair
1.26 - 1.34	Passable
1.35 - 1.45	Poor
1.46 - 1.59	Very Poor
$\geq$ 1.60	Extremely Poor

The AOR analysis was utilized as a crude measure of flowability. It showed the angle at which the powder rested on a stationary conical heap. It was also the degree formed by the heap slope towards to horizontal base after the seasoning powder was poured freely. This mechanism mimicked the

process of pouring powder into a hopper in manufactures (Juliano & Barbosa-Cánovas, 2010). The AOR was determined by using a powder flowability tester from Copley Scientific (**Appendix 3**). The apparatus was prepared appropriately according to the instructions from Copley Scientific. The funnel was fixed at a particular height which already set on the equipment. A 100 gram of kimchi seasoning powder freely passed through the funnel, forming a conical pile on the test platform or base. Nevertheless, a stirrer was possible to be used to assist in the flow of more cohesive powder. The data sampling was taken in triplicate and averaged for each type of samples.

As seen in equation **(1)**, the tangent of the AOR was observed by reading off the height of the powder cone in the unit of millimeter from the digital display of the height gauge and dividing it by 50 millimeters. Subsequently, it was then calculated to inverse tangent in order to obtain the angle in degrees. The degree values of AOR indicated a certain flow property which can be seen in **Table 4** (Moravkar et al., 2020).

$$\theta = tan^{-1}\left(\frac{Height\ of\ Cone\ (mm)}{50\ mm}\right) \quad \textbf{(1)}$$

Table 4. Corresponding AOR and flow properties

AOR (°)	Flow Properties
25 - 30	Excellent
31 - 35	Good
36 - 40	Fair - aid not required
41 - 45	Passable - may hang up
46 - 55	Poor - must agitate, vibrate
56 - 65	Very Poor
≥ 66	Extremely Poor

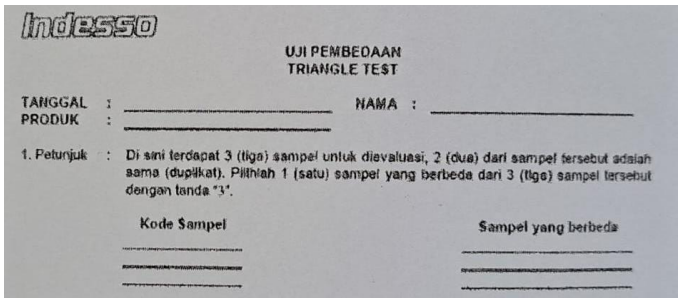
3.2.3 Sensorial Analysis

The sensory evaluation could be done by discriminative and/or descriptive tests. The discriminative tests were used to determine the differences between samples. On the other hand, the descriptive tests were utilized to obtain a more detail description of samples (Singh-Ackbarali & Maharaj, 2014). The triangle test was one of the discrimination tests which was conducted to determine whether there was a distinguishable sensory difference or not between two samples. This test was suitable to evaluate overall product differences (Sinkinson, 2017). However, the triangle test did not detect any specific differences among the samples (Sharif et al., 2017; Sinkinson, 2017).

The sensory test was done by conducting a triangle test for each trial sample. The triangle test tested three coded test samples. The two samples were identical, whereas, the other sample was different. All of the three samples were coded differently. The panelists were asked to assess all the three samples and pick the different samples from the other two samples. The serving order to the panelists was also random. The correct answer was when the panelists were able to choose an odd sample out of the three samples. Otherwise, their answer would be categorized as a wrong answer.

The triangle tests were done twice. The first triangle test was done to assess the control sample with T1 sample. Subsequently, the second triangle test was done to assess the control sample with T2 sample. In each triangle test, a trial sample was tested with the approved seasoning powder which was known as the control. Each of the panelists were given two panel papers for two triangle tests which can be seen in **Figure 6**. The triangle tests were conducted on 40 panelists. Most of the panelists were trained and semi-trained panelists in which they were the employees of PT Indesso Culinaroma Internasional, including the Product Development Department, Quality Control Division, as well as the

Quality Assurance Department. The untrained panelists were the internees of PT Indesso Culinaroma Internasional, securities, and others.


Indesso

UJI PEMBEDAAN
TRIANGLE TEST

TANGGAL : _____ NAMA : _____
PRODUK : _____

1. Petunjuk : Di sini terdapat 3 (tiga) sampel untuk dievaluasi, 2 (dua) dari sampel tersebut adalah sama (duplikat). Pilihlah 1 (satu) sampel yang berbeda dari 3 (tiga) sampel tersebut dengan tanda "1".

Kode Sampel	Sampel yang berbeda
_____	_____
_____	_____
_____	_____

Figure 6. Panel paper used by the panelists

3.2.4 Statistical Analysis

3.2.4.1 Kruskal-Wallis Test

The results of HR values were further analyzed using Kruskal-Wallis Test in order to find the significance of the samples on the free-flowability. This non-parametric test is suitable to be utilized in the analysis in order to determine the significance of the different reformulated samples (T1 using powder-based capsicum and T2 using powder-based capsicum with SiO_2) from the control kimchi seasoning powder in terms of their flowability properties. The analysis was computed using IBM SPSS Statistics 26. The hypothesis for HR analysis were as follows:

a. Null hypothesis (H_0) : There is no significance difference between reformulated sample (T1 and T2) and the control sample.
b. Alternative hypothesis (H_1) : There is significance difference between reformulated sample (T1 or T2) and the control sample.

3.2.4.2 Chi-square Distribution Test

The results of the sensory analysis were further analyzed statistically. The independent variable of the sensory analysis was the types of sample. Meanwhile, the dependent data of the sensory analysis was the number of correct and wrong answers in each triangle test. Since the dependent data was nominal data, therefore, the Chi-square Distribution Test was suitable to be utilized in the analysis in order to determine the significance of the different reformulated samples (T1 using powder-based capsicum and T2 using powder-based capsicum with SiO_2) from the control kimchi seasoning powder in terms of the sensorial properties. The equation to calculate the chi square was shown in equation **(2)**. For each of the triangle test, the hypothesis were as follows:

a. Null hypothesis (H_0) : There is significance difference between reformulated sample (T1 or T2) and the control sample.
b. Alternative hypothesis (H_1) : There is no significance difference between reformulated sample (T1 or T2) and the control sample.

$$X^2 = \frac{[|(O_1 - E_1)| - 0.5]^2}{E_1} + \frac{[|(O_2 - E_2)| - 0.5]^2}{E_2} \qquad \textbf{(2)}$$

Note:

X^2 = Chi squared
O_1 = Number of correct answer
E_1 = Expected correct answer = n*$P_{\text{Chance of Correct Answer}}$
O_2 = Number of false answer
E_2 = Expected false answer = n*$P_{\text{Chance of False Answer}}$

3.3 Results and Discussions

The flowability of powder are mainly affected by friction, cohesion, and adhesion. The cohesion force is the attraction among particles. On the other hand, the adhesion force is the attraction that occurs between particle and wall surface (Barbosa-Cánova, 2021). The HR and AOR are the common methods to test the free flowability of powder. The HR was defined as the ratio of a powder's compact density to its loose bulk density (Moravkar et al., 2020). The powder's loose bulk density is a density that is measured after the powder is freely poured into a graduated container. Meanwhile, the powder's compact density is obtained after the powder is compressed by mechanical pressure and/or vibration tapping which causing powder compaction (Micha, 2011). The HR is used to indicate the compressibility of powders which also shows the internal friction index for cohesive powders (Abdullah et al., 2010).

The AOR, on the other hand, is the angle of inclination of the unconstrained surface to the horizontal of the powder heap (Schlick-Hasper et al., 2022). Generally, it is used to monitor the bulk powder. This analysis is beneficial to predict the powder's ability to pass through hoppers and silo. Cohesive powders are able to form rigid structures, known as ratholes within the hopper's wall which can be seen in **Figure 7**. The ratholes will be formed as the results of the powder interaction with the hopper's wall and other powder particles. The accumulation of ratholes will stick onto the hopper's wall and create areas of no-flow within the hopper, hence, it will limit the powder to passthrough the hopper (Hazlett et al., 2021).

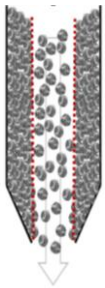


Figure 7. Ratholes within a hopper's wall (Hazlett et al., 2021).

AOR under 30° shows a good flowability, 30° – 45° indicates some cohesiveness in the powder, 45° – 55° is identified as true cohesiveness, whereas above 55° is categorized to be a highly cohesive powder and has limited free flowability. Lower AOR indicates lower cohesiveness of a bulk solid material which means higher free-flowability of the bulk solid material. Any powder or granular material is considered to have a good flowability when it has a low HR and/or AOR (de Campos & Ferreira, 2013).

3.3.1 The Effects of Liquid to Solid Ingredient Substitution in the Reformulation on Flowability Properties

The flowability properties were analyzed based on the HR as well as AOR of the samples. The results of the flowability properties of kimchi seasoning powder were shown in **Table 5**. The values of HR and AOR were interpretated accordingly to the corresponding method which were shown in **Table 3** and **Table 4**, respectively. T1 sample had lower HR compared to the control sample. This indicates that the reformulated samples had improved free flowability properties. Nevertheless, the T1 sample was still had very poor flowability properties, indicating that it had less free flowing properties (Buanz, 2021). Furthermore, the Kruskal-wallis Test showed that the significance value was 0.202 (P>.05), indicating that the improved HR value was not significant compared to the control sample. Meanwhile

as seen in **Table 5**, the AOR of the trial samples were lower compared to the control sample. However, all of the samples were still categorized to have a very poor flowability properties.

Table 5. Flowability properties of kimchi seasoning powder

Samples	HR (n=3)		AOR (n=1)	
	Average	Note	AOR (°)	Note
Control	1.6101 ± 0.0672[a]	Extremely Poor	52.29	Very Poor
T1	1.5420 ± 0.030 [a]	Very Poor	51.32	Very Poor
T2	1.5079 ± 0.0444 [a]	Very Poor	50.65	Very Poor

The flowability properties of the samples showed that the reformulation improved the free flowability of the kimchi seasoning powder (**Table 3**). Substituting one of the ingredients, particularly the capsicum oleoresin liquid into encapsulated oleoresin powder could lower the HR as well as AOR. This is due to the small changes in the form of one of the ingredient affected the particle size and surface properties of the seasoning powder (Moravkar et al., 2020). Lower HR and degree of AOR show that cohesiveness is decreasing and the particle size of the powder is increasing which allow the powder to flow more freely (Schlick-Hasper et al., 2022). By substituting the liquid ingredient into solid encapsulate form, it improves the flowability and prevents caking (Fernandes et al., 2013). Nevertheless, the improved flowability properties was insignificant due to the fact that there were other factors contributing the free-flowability as well, including other ingredients which have different flowability properties.

The findings of this study aligned with other study in which changing the composition of food powders during formulation was reported to affect the loose bulk density and the powder's compact density. According to a study by Szulc & Lenart (2016), the addition of coating materials, particularly the 15% lactose solution in the raw ingredients composition of wheat porridge powder significantly decreased the HR. It was due to the significantly increased particle size of powder. Therefore, there was a correlation between composition of powder and its flowability (Szulc & Lenart, 2016). The liquid content (e.g. moisture and liquid fat) in the seasoning powder and moisture from the environment may condense at within the powder. This leads to a strong attractive capillary force which causes the formation of cohesive liquid bridges among particles. These interparticle bridges induces the powder caking. Therefore, the effects of liquid ingredient utilization should be considered (Hazlett et al., 2021).

3.3.2 The Effects of Anti-caking Agent in the Reformulation on Flowability Properties

The T2 samples was shown to have the lowest HR and AOR compared to the control and T1 sample, although it was still categorized to be very poor of flowability (**Table 5**). Nevertheless, the Kruskal-Wallis Test showed that the significance value was 0.202 (P>.05), indicating that flowability of T2 sample was not significantly different compared to the control sample. Other than the substitution of encapsulated capsicum oleoresin liquid into the powder form, the T2 sample also was added with SiO_2 which acts as the anti-caking agent in the kimchi seasoning powder. The SiO_2 is an inorganic powder which is labeled as E551 under the food ingredient list. It minimizes the caking risk of powder by absorb moisture faster than the host powder, since it has more surface area. This causes the hygroscopicity reduction in the host powder, thus, reducing the risk of caking (Larsson, 2016). Furthermore, the SiO_2 also capable to reduce the internal friction or the cohesion force by smoothing the surfaces of the particles (Nurhadi et al., 2020). These results showed that the addition of anti-

caking agent, particularly the SiO_2 into the kimchi seasoning powder exhibited better flowability properties rather than substituting the raw ingredient into the powder. Nevertheless, the insignificant improved free-flowability of T2 sample was maybe due to the insufficient amount of anti-caking agent added into the sample and/or the choice of other anti-caking agent which causing the interaction of the anti-caking agent with the host powder to be less effective to improve the flowability. According to Juliano & Barbosa-Cánovas (2010), the incorporation of anti-caking agent also had the effect to increase the loose bulk density of powder which can be indicated by the decreasing of HR. This finding aligned with the result of this study. Nevertheless, there were only few researches that studied about the influences of anti-caking agent on the free-flow of powders (Addo et al., 2020). A study done by Addo et al. (2020) reported that the jujube powders with anti-caking agent were able to improve the stability of jujube powders and coat the powder particles. Hence, inducing lower cohesion force among particles as well as lower caking rate on the materials.

3.3.3 The Effects of Reformulation on the Sensorial Properties

The results of triangle test that was done to assess the reformulated kimchi seasoning powder compared to the control sample which were applied on nett base (**Table 6**). The triangle test that were used to assess the T1 and T2 samples showed that 37.5% and 32.5% of the panelists were able to answer correctly, respectively. It can be deduced that the T2 sample was harder to differentiate with the control sample, indicating that the T2 sample had more similarities with the control in terms of the sensory profile. The chi-squared values of each samples was also included in **Table 6** in which they were calculated by using **equation (2)**. The chi-squared value of the triangle test to assess T1 and T2 samples were 0.1596 and 0.0041 respectively. The critical value (df=1; α=0.05) is 3.841. Since the X^2 for both samples were less than the critical value, therefore, it can be deduced that the null hypothesis is rejected. Thus, both of the reformulated kimchi seasoning powders (T1 and T2 samples) had no significance difference with the control sample. Based on the sensorial analysis, it implied that the reformulated samples had similar sensorial properties with the existing kimchi seasoning powder, although there had been changes in the ingredient. Nevertheless, it was inevitable that the panelists in these triangle tests may had sensory fatigue which may affect the results of the triangle test.

Table 6. Results of triangle tests

Samples	Answers of Triangle Test (n=40)		Chi-Squared
	Correct	False	
T1	15	25	0.1596
T2	13	27	0.0041

Critical value (df=1; α=0.05) = 3.841

3.4 Conclusion and Recommendation

3.4.1 Conclusion

Free-flowability of powders is one of the crucial physical properties that highly affect the utilization of powders. The development of kimchi seasoning powder in order to improve its free flowability was done by comparing the flowability and sensorial properties of the substitution of the liquid to powder raw ingredients and the utilization of anti-caking agent into the powder. The flowability properties of

kimchi seasoning powder was evaluated by using the Hausner Ratio (HR) and Angle of Repose (AOR). The kimchi seasoning powder with the substitution of a liquid to powder ingredient as well as the addition of SiO_2 as the anti-caking agent had lower HR and AOR, thus, inducing better flowability properties compared to the kimchi seasoning powder with only ingredient substitution. Nevertheless, by using the Kruskal-wallis Test, the results accepted the null hypothesis that the reformulated samples (T1 and T2 samples) had insignificant difference with the control samples in terms of the flowability properties.

Any perceptible sensory differences between the reformulated and the control samples were tested by using triangle tests. Most panelists were not able to distinguish both of the reformulated samples when compared to the control. Thus, the null hypothesis of the sensory evaluation was rejected. This indicated that the reformulated samples had no significance difference in terms of sensory attributes to the control sample. Despite of the ingredients reformulation of the powder, its flowability properties are also affected by other particle properties (e.g. moisture and particle size and shape) and powder properties (e.g. size distribution and cohesiveness) in which are influenced by intrinsic factors (e.g. temperature and relative humidity) as well as external factors (e.g. feeding rate, vibration, and hopper's designs), respectively.

3.4.2 Recommendation

Further studies could focus to explore another solutions to improve the flowability properties significantly for kimchi seasoning powder other than substituting liquid- to powder-based ingredients as well as utilization of anti-caking. This was due to the fact the the flowability properties of kimchi seasoning powder may be affected by other factors as well. Other than that, the analysis on the particle size of powder could be conducted to have an detailed observation on the effects of the powder reformulation on its flowability properties. Further studies could also conduct analysis with regards to the shelf life and moisture content of the powder in order to observe the effect of storage on the seasoning powder and find the main factor that caused the caking problems. Furthermore, the sensory analysis was done only by a basic discriminative test in this study. Further studies with similar topic are better to conduct other descriptive test as well. Therefore, the sensory profile of the seasoning powder can be discussed more detailed.

CHAPTER 4: SELF REFLECTION

This internship opportunity became a new working experience that could not be forgotten. An evaluation was discussed in this chapter as a self-reflection which may be useful for the next steps of career. This included the elaboration of reflection during internship as well as the impacts of i3L as an education institution for the past years.

4.1 New Skills Gained in Internship

Having the opportunity to do an internship at PT Indesso Culinaroma Internasional really helped the author to have working experiences and glympse of working in a business-to-business company focusing in the seasonings for food and beverage. The author had gained many new skills that would be useful for pursuing career in the future, particularly in food ingredients company. For instance, the author learned a lot about exploring and improving the sensory profile for food, especially snack bases. Furthermore, the author also was introduced to various types of raw ingredients which had different flavor, thus, the author had the opportunity to characterize many flavors by identifying the top note, basic note, and their after taste. In addition, the author also gained new experiences in the development of seasoning powder and its application in terms of its sensory profile that was done by the developers.

4.2 Strength and Weakness during Internship

Working for the first time in a food ingredients industry, the author was faced with new situations in which an adaptation was occurred and causing the author to realize with the strength and weakness during working. Since, the given tasks were a day-to-day basis and time-crucial work, the author was able to manage the work efficiently and on schedule. Furthermore, the author was able to create a tidy and clean working environment as what had been done by all of the employees in the office. The author was also determined to be better in terms of working performance by evaluating the difficulties that were encountered. Nevertheless, the working that was done by the author was hindered by the lack of knowledge and experiences in certain products which caused the tasks had to be done longer than predicted.

4.3 Contribution of i3L and its Values

As a premium higher education, i3L has embed their core values to their students in daily basis. Their core values were felt to be impactful to the characters of the author. These core values and their contributions to the benefits were as follows:

a. Grit

   Grit refers to an individual personality to persevere and passionate in achieving goals as well as driven to be courageous despite of the obstacles and limitations along the process. This particular value plays an important role in the workplace. For instance, different tasks were given during the internship with time limit, since most of the internship tasks were on a daily basis. Nevertheless, the author did not consider it as an obstacles, but as a challenge to complete the tasks within a given period of time.

b. Role-model

   Role-model defines as a body who inspires people in achieving certain goals by emulating his/her behaviors and attitudes. By trying to become a positive role-model during internship, the characters and behaviors of the author should be well-mannered, maintaining a good relationship with others, as well as having a good working performance for the company. These conditions has been applied by the author during internships although the author still needs to learn a lot from other people.

c. Integrity

   Integrity means that treating one another with moral and respect. Oneself intention should precedes its action and impacts. The author has been trying to do the internship tasks with conscience. Any mistakes should be reported so that its impact could be anticipated by discussing together with other people. Subsequently, an evaluation should be done in order to prevent the same mistakes to be repeated.

As an institution to pursue a bachelor degree, i3L had been an educative place to gain more knowledge about food as well as integrity as a college student. The complete and advance laboratory facilities allows the students to be able to explore many thing in-depth during classes and projects. Thus, the thinking ability of the students were tested to be more critical. The knowledge that were obtained would be different in i3L and other places.

For the past 3 years, the BRIGHT Sessions that had been held by i3L regularly were really enriched the non-academic knowledge, starting from the fundamental learnings until the advanced and specific talks. The mandatory requirements to join the BRIGHT Sessions made the author realized how important the sessions were. For instance, about the personal branding that had been introduced in the first year of university. Nevertheless, the elective BRIGHT Sessions were also as important as the mandatory BRIGHT Sessions, including the sessions to meet with the alumni from all majors. These sessions were useful to have insights of the alumni's journeys from studying in i3L until pursuing their careers after graduation.

4.4 Student Impact on the Workplace

During internship, the author had some contributions for PT Indesso Culinaroma Internasional which were as follows:

d. Develop applications for various snack bases for the Sales & Marketing team as well as clients,
e. Pack the seasoning powders and/or applications for the clients,
f. Develop snack bases making when required.
g. Assist in the development of seasoning powder, including diluting the seasoning powder and color analysis for sensory evaluation, and
h. Data input for incoming bases, target products, and samples from suppliers and clients.

CHAPTER 5: CONCLUSION & RECOMMENDATION

A brief summary of this internship which included the main project was defined in this chapter. The recommendations for further internship opportunity were stated in order to enhance the quality of this internship.

5.1 Conclusion

The internship was conducted at PT Indesso Culinaroma Internasional in the Department of Product Development in the unit of Innovation & Application (Snack). For the past five months, this internship opportunity provided a new working experience in a food ingredient industries which beneficial for pursuing future career. New skills were more developed during this internship which served as the practical implementation of the knowledge that had been obtained during learning in the university.

The scope of work during this internship included the sample and application preparation for Sales and Marketing team, flowability testing and sensorial testing for applied snack with kimchi seasoning powder, as well as new product development (chicken and beef crackers). Most of the goals had been achieved in this internship. Nevertheless, the development of chicken and beef crackers were still in progress. The formulation for the chicken cracker was still on progress. Meanwhile, the formulation for the beef cracker had been determined, but still required the evaluation from the client. Regarding the kimchi seasoning powder project, this study found that the kimchi seasoning powder with the combination of substitution of a liquid to powder ingredient with the addition of SiO_2 as the anti-caking agent had the lowest Hausner Ratio (HR) and Angle of Repose (AOR) compared to the other samples. Hence, it had better flowability properties compared to the kimchi seasoning powder with only ingredient substitution. Although the flowability and sensorial test for the kimchi seasoning powder had achieved the objectives of the project, but the development of the reformulated kimchi seasoning powder was better to be continued in order to obtain a kimchi seasoning powder with good free-flowability.

5.2 Recommendation

The eagerness to learn something new every day was a crucial spirit in this internship because in this opportunity, everyone could learn about sensory profile while also working in the Product Development Department. Nevertheless, working with a good time management was beneficial to get the internship activities done on time. Further study could continue to improve the development of kimchi seasoning powder as well as the development of chicken and beef crackers. The storage analysis could be done for both projects in order to estimate the shelf life as well as the physical and sensorial properties overtime.

REFERENCES

Abdullah, E. C., Salam, A. M., & Aziz, A. R. (2010). Cohesiveness and Flowability Properties of Silica Gel Powder. *Physics International, 1*(1), 16–21. https://doi.org/10.3844/pisp.2010.16.21

Addo, K. A., Bi, J., Chen, Q., Bhandari, B., Lyu, J., Wu, X., … Li, C. (2020). Assessment of Anticaking Agent on Caking Behavior of Jujube Amorphous Powder via Glass Transition and State Diagram. *Food and Bioprocess Technology*. https://doi.org/10.1007/s11947-020-02493-y

Barbosa-Cánova, G. V. (2021). Food Powders Properties and Characterization. In E. Ermiş (Ed.), *Food Engineering Series*. Springer International Publishing. https://doi.org/10.1007/978-3-030-48908-3

Buanz, A. (2021). Powder characterization. *Remington*, 295–305. https://doi.org/10.1016/b978-0-12-820007-0.00016-7

de Campos, M. M., & Ferreira, M. do C. (2013). A Comparative Analysis of the Flow Properties between Two Alumina-Based Dry Powders. *Advances in Materials Science and Engineering*, 1–7. https://doi.org/10.1155/2013/519846

Fernandes, R. V. de B., Borges, S. V., & Botrel, D. A. (2013). Influence of spray drying operating conditions on microencapsulated rosemary essential oil properties. *Ciência e Tecnologia de Alimentos, 33*(1), 171-178.

Freeman, T., Brockbank, K., & Armstrong, B. (2015). Measurement and Quantification of Caking in Powders. *Procedia Engineering, 102*, 35–44. https://doi.org/10.1016/j.proeng.2015.01.104

Hazlett, R., Schmidmeier, C., & O'Mahony, J. A. (2021). Approaches for improving the flowability of high-protein dairy powders post spray drying – A review. *Powder Technology, 388*, 26–40. https://doi.org/10.1016/j.powtec.2021.03.021

Larsson, A. (2016). *Evaluation of Natural Anti-caking Agents in Spices and Spice Blends*.

Lipasek, R. A., Ortiz, J. C., Taylor, L. S., & Mauer, L. J. (2012). Effects of anticaking agents and storage conditions on the moisture sorption, caking, and flowability of deliquescent ingredients. *Food Research International, 45*(1), 369–380. https://doi.org/10.1016/j.foodres.2011.10.037

Micha, P. (2011). Physical Properties of Food Powders. Food Engineering. *Encyclopedia of Life Support Systems (EOLSS)*.

Moravkar, K. K., Korde, S. D., Bhairav, B. A., Shinde, S. B., & Chalikwar, S. V. K. and S. S. (2020). Traditional and Advanced Flow Characterization Techniques: A Platform Review for Development of Solid Dosage Form. *Indian Journal of Pharmaceutical Sciences, 82*(6), 945–957. https://doi.org/10.36468/pharmaceutical-sciences.726

Nurhadi, B., Sukri, N., Saputra, R. A., Wandhani, F. I., & Nurlita, A. I. (2020). Physical Characteristics of Amorphous and Crystalline Coconut Sugar Powder with the Addition of Tricalcium Phosphate (TCP) as an Anticaking Agent. *International Journal of Food Science*. https://doi.org/10.1155/2020/5320173

Prime, D. C., Leaper, M. C., Jones, J. R., Richardson, D. J., Rielly, C. D., & Stapley, A. G. F. (2011). Caking Behaviour of Spray-Dried Powders - Using Scanning Probe Microscopy to Study Nanoscale Surface Properties and Material Composition. *Chemical Engineering & Technology, 34*(7), 1104–1108. https://doi.org/10.1002/ceat.201000537

Pui, L. P., Karim, R., Yusof, Y. A., Wong, C. W., & Ghazali, H. M. (2020). Anti-caking Agent Effects on the Properties of Spray-dried "Cempedak" Fruit Powder. *Pertanika Journal of Tropical Agricultural Science, 43*(4). https://doi.org/10.47836/pjtas.43.4.15

Schlick-Hasper, E., Bethke, J., Vogler, N., & Goedecke, T. (2022). Flow properties of powdery or granular filling substances of dangerous goods packagings—Comparison of the measurement of

the angle of repose and the determination of the Hausner ratio. *Packaging Technology and Science, 35*(10), 765–782. https://doi.org/10.1002/pts.2678

Sharif, M. K., Butt, M. S., Sharif, H. R., & Nasir, M. (2017). Sensory Evaluation and Consumer Acceptability. *Handbook of Food Science and Technology*.

Singh-Ackbarali, D., & Maharaj, R. (2014). Sensory Evaluation as a Tool in Determining Acceptability of Innovative Products Developed by Undergraduate Students in Food Science and Technology at The University of Trinidad and Tobago. *Journal of Curriculum and Teaching, 3*(1). https://doi.org/10.5430/jct.v3n1p10

Sinkinson, C. (2017). Triangle Test. *Discrimination Testing in Sensory Science*, 153–170. https://doi.org/10.1016/b978-0-08-101009-9.00007-1

Szulc, K., & Lenart, A. (2016). Effect of composition on physical properties of food powders. *International Agrophysics, 30*(2), 237–243. https://doi.org/10.1515/intag-2015-0084

Tahmaz, J., Begić, M., Oručević Žuljević, S., Mehmedović, V., Alkić-Subašić, M., Jurković, J., & Djulanćić, N. (2022). Physical Properties of Vegetable Food Seasoning Powders. *10th Central European Congress on Food*, 14–32. https://doi.org/10.1007/978-3-031-04797-8_2

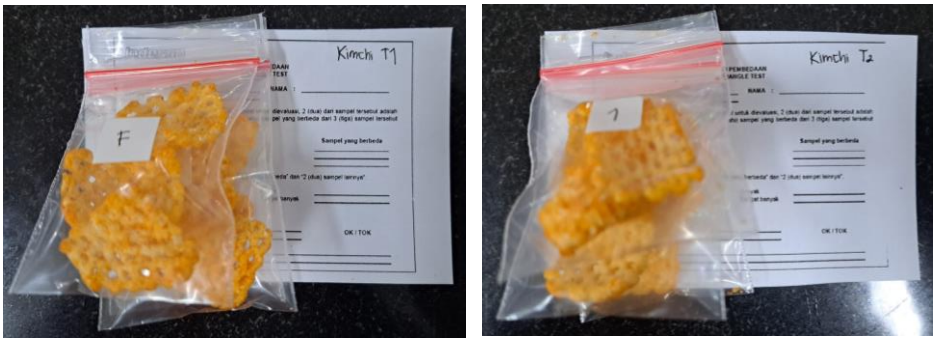
Yapıcı, E., Karakuzu-İkizler, B., & Yücel, S. (2020). Anticaking Additives for Food Powders. *Food Engineering Series*, 109–123. https://doi.org/10.1007/978-3-030-48908-3_6

APPENDICES

Appendix 1. A 100-mL measuring cylinder. Source: https://www.labfriend.co.id/measuring-cylinder-duran-reg-class-a-blue-graduation-6083-666

Appendix 2. An analytical balance. Source: https://www.mt.com/ch/en/home/products/Laboratory_Weighing_Solutions/analytical-balances/ME204-M.html

Appendix 3. A powder flowability tester from Copley Scientific. Source: https://www.medicalexpo.com/prod/copley-scientific/product-89673-719688.html



(a) (b)

Appendix 4. Samples and paper for the panelists for triangle test to assess: (a) T1 sample; (b) T2 sample.

Appendix 5. Kimchi seasoning powder making by incorporating several ingredients.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of HR is the same across categories of Sample.	Independent-Samples Kolmogorov-Smirnov Test	.[a]	Unable to compute.
2	The distribution of HR is the same across categories of Sample.	Independent-Samples Kruskal-Wallis Test	.202	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,050.

a. The group field does not have exactly two values.

Appendix 6. Kruskal-wallis Test Result: Hypothesis Test Summary

Independent-Samples Kruskal-Wallis Test Summary

Total N	9
Test Statistic	3.200[a,b]
Degree Of Freedom	2
Asymptotic Sig.(2-sided test)	.202

a. The test statistic is adjusted for ties.

b. Multiple comparisons are not performed because the overall test does not show significant differences across samples.

Appendix 7. Kruskal-wallis Test Result.

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