4 DISCUSSION

Non-dairy creamer was the product that did not make from milk and had other fats than cream as ingredients or creamer that contains cream less than 30% (Rosida et al., 2016). Vegetable fat or oil is generally used as an essential ingredient in coffee whiteners, for it provides whitening powder, body, and viscosity. Most of the non-dairy creamer was made from coconut and palm kernel oil, which was available as a powdered, liquid, and frozen form and had a significant role in reducing the color of coffee and tea and provides flavor (Katsri et al., 2014). The Vana Blanca 60 Fat pilot plan generally has the same composition as the current Vana Blanca 60 Fat; however, the difference is in the composition of the emulsifier. At the current Vana Blanca 60 Fat, the emulsifier used is E471: Mono- and diglycerides of fatty acids containing palm oil. However, the new sample of Vana Blanca's 60s pilot plan used a palm oil emulsifier and replaced it with rapeseed oil. Rapeseed oil contains low amounts of saturated fatty acids (<7%), which had adverse health effects, and relatively high amounts of polyunsaturated linoleic (ω-6) acid and α-linoleic (ω-3) fatty acids, which linked to preventing cardiovascular disease (Kraljić et al., 2013). In this study, there were five samples used, four samples of Pilot plan Vana Blanca 60 Fat, and 1 sample of current Vana Blanca 60 Fat as a control. The pilot plan Vana Blanca 60 Fat consists of four samples with two different emulsifier brands and has different emulsifier concentrations for each brand, which is 1% and 1.25%.

4.1 Chemical Characteristics

Fat content is the main factor that is greatly affected in this project. Where one component of the material used has changed from its oil content. The fat content will also affect the performance of the emulsion on NDC. Fat crystals influence emulsion stability in general; colloidal particles influence the stability of emulsions when attached to emulsion droplets (Johansson et al., 1995). Besides, Vana Blanca's 60s has unique high-fat content (59.5% -61.5%), so the fat content must be prioritized. So far, the existing Vana Blanca 60 Fat uses the Distilled mono- & diglyceride E471 emulsifier. Mono- and diglycerides were emulsifiers that commercially manufactured by combining vegetable oil with vegetable-based glycerin (Cassiday, 2016).

In Table 7, it can be seen that at a 95% confidence level ($\alpha = 0.05$) there is no significant difference in changes in oil-based emulsifier on fat content. The four samples already have high-fat content; however, the sample S0161 does not meet the NDC standards because the fat content is below 59.5%. Whereas in the sample S0162, the fat content meets the NDC standard, as well as S0163 and S0164. With the high-fat content, NDC has a high risk of fat oxidation that can cause a decrease in the emulsion. Lipid oxidation is another important consideration when evaluating an emulsifier. Negatively charged emulsifiers may reduce shelf life in an o/w emulsion because they can attract positively charged transition metals, such as iron, that promote lipid oxidation.

In contrast, positively charged emulsifiers repel like-charged transition metals, potentially reducing lipid oxidation (Cassiday, 2016). With this emulsifier, replacement with rapeseed oil can help solve fat oxidation because rapeseed oil naturally presents bioactive compounds such as tocopherols, phytosterols, and polyphenols, which can help protect against oxidation activity. Rapeseed oil contains a high amount of tocopherols (430-2,680 mg/kg), which are efficient natural antioxidants; the dominant tocopherol homologs in rapeseed oil are γ- and α-tocopherol, while β- and δ-tocopherol are present at very low or undetectable concentrations. Rapeseed oil was also a good source of phytosterols (4,500-11,300 mg/kg). Phytosterols prevent polymerization in oils during thermal processing (Kraljić et al., 2013). Besides lengthen shelf life, negatively charged emulsifiers may require antioxidants, especially those targeted to the lipid interface (Cassiday, 2016). Rapeseed oil is rich in monounsaturated fatty acids in omega-3 fatty acids and is low in saturated fatty acids in comparison to other edible oils. High oleic rapeseed has an increased monounsaturated fatty acid content, which gives better health stability during frying than that of standard rapeseed oil (Fediol, 2011). Rapeseed oil was one of the essential oils for human nutrition worldwide. FAO statistics for 2010 show that rapeseed oil ranked third in production volume, after palm and soybean oils (Kraljić et al., 2013).

Ash refers to the inorganic residue remaining after either ignition or complete oxidation of organic matter in a foodstuff. Two significant types of ashing used: dry ashing, primarily for proximate composition and for some types of specific mineral analyses; wet ashing (oxidation), as a preparation for the analysis of certain minerals. Dry ashing refers to the use of a muffle furnace capable of maintaining temperatures of 500-600°C. Water, volatiles vaporized, and organic substances were burned in the presence of oxygen in the air to CO2 and oxides of N2. The advantages of conventional dry ashing are that it is a safe method, requires no added reagents or blank subtraction, and little attention is needed once ignition usually begins a large number of crucibles can handle at once. Also, use the resultant ash can in other analyses for most individual elements, acid-insoluble ash, water-soluble, and insoluble ash. The disadvantages were the required length of time (12–18 h or overnight) and expensive equipment (Marshall, 2007). Ash content value of non-dairy creamer could be seen in Table 8. The Table showed that the ash content obtained from each sample is below 5% and meets the product sample specification. The range value of fat content for non-dairy creamer sample respectively are 4.10%; 4.15%; 4.15%; 4.27%; and 4.83%. From the results, it can be seen that the samples of NDC had an average that was not much different from the control at a 95% confidence level (α = 0.05). Fats, oils, and shortenings ash content vary from 0.0 to 4.1% ash while dairy products vary from 0.5 to 5.1%, ash content average of various food was a different one and another (Marshall, 2007).

The protein content value of non-dairy creamer could be seen in Table 9. It could be seen that the average of the protein content of each sample at a 95% confidence level (α = 0.05), was not affected much by the change in the emulsifier, which is 4.0% - 4.5% and still meets the specification of NDC. This also shows that the replacement using an emulsifier based on rapeseed oil does not affect changes in protein levels in NDC, where protein content is related to the amount of sodium caseinate. Treatment addition of sodium caseinate on the non-dairy creamer significantly effect on protein content, flavor, and color brightness level of the product (Rosida et al., 2016). In the Kjeldahl procedure, proteins and other organic food components in a sample digested with sulfuric acid in the presence of catalysts. The total organic nitrogen converted to ammonium sulfate. The digest is neutralized with alkali and distilled into a boric acid solution. The borate anions formed are titrated with standardized acid, which converted to nitrogen in the sample.

The result of the analysis represents the crude protein content of the food since nitrogen also comes from no protein components (Marshall, 2007). Furthermore, protein concentrates have one functional property, water absorption (water holding capacity, WHC), which may affect the water content of a product. Water holding capacity (WHC) is the ability of proteins to prevent water from being released or expelled from their three-dimensional structure. Protein ingredients with very high WHC may dehydrate other ingredients in a food system. Proteins with low WHC could be more sensitive to storage humidity. WHC is the amount of water trapped in the protein matrix under certain conditions. Water-holding capacity (WHC) is an important protein–water interaction that occurs in various food systems. WHC represents the ability of a protein matrix to absorb and retain bound, hydrodynamic, capillary, and physically entrapped water against gravity (Srinivasan Damodaran, 2013). Based on that, Low protein content has a good effect on NDC because it will keep the moisture content at a low level, and it could offer performance and maintain the NDC shelf life.

The moisture content value of non-dairy creamer could be seen in Table 10, it can be seen that at a 95% confidence level (α = 0.05), there is no significant difference in changes in oil-based emulsifier on moisture content. The Table showed the moisture content of each sample NDC has a value below the maximum standard of moisture content, which is 2.6%. This also shows that the emulsifier replacement based on rapeseed oil does not provide a significant change effect on the moisture content. Moisture content is a critical factor that may influence the shelf life of the product. When the product had a low moisture content then the shelf life of the product would be longer. Furthermore, the lower moisture content and the force of attraction between the particles will be more durable so that the space between them will be smaller (low porosity), causing the higher bulk density (Rosida et al., 2016).

4.2 Physical Characteristics

The bulk density tapped and coffee test result could be seen in Table 11. Bulk density calculated based on the volume of a particular product. Granules or droplets more significant cause higher volume needed than small gain flour (Rosida et al., 2016). The bulk properties of food powders were a function of physical and chemical properties of the material, the geometry, size, and surface characteristics of the individual particles, as well as the system's history as a whole (Ortega-rivas, 2005). The bulk density that was conducted in this research is tapped bulk density; for many food powders, which are more likely cohesive in behavior, the terms more commonly used to express bulk density are loosely poured and tapped bulk density, after vibration. The bulk tap density, as implied by its name, is the bulk density of a powder that has been settled into closer packing than existed in the poured state by tapping, jolting, or vibrating the measuring vessel. As with poured bulk density, the volume of a particular mass of powder may be observed, but it was generally better to measure the mass of powder in a fixed volume (Ortega-rivas, 2005). The tapped bulk density value of non-dairy creamer could be seen in Table 12. At a 95% confidence level (α = 0.05), there is no significant difference in changes in oil-based emulsifier on bulk density. The bulk density value has a minimum of 475.00 g/L and a maximum of 509.47 g/L, where both values meet the product specification standard (460 g/L – 530 g/L). Good bulk density was affected by the water content of a product. Bulk density tendency was inversely proportional to the density of water content, the lower the water content, the higher the bulk density (Rosida et al., 2016). This can be proven by the low level of moisture content (Table 10). Moisture sorption is generally associated with increased cohesiveness, mainly due to inter-particle bridges. Many food powders are highly hygroscopic and, therefore, high moisture contents would result in lower loose bulk density. Although sugar and salt were examples of powders that lower their densities were resulting from increased humidity, more fine powders (e.g., baby formula and coffee creamer) that were very cohesive even in their dry form do not present such a trend. For these powders, it appears that the bed array has reached maximum voidage at low moisture contents, and further lowering of the density becomes impossible (Ortega-rivas, 2005).

Besides, bulk density is also related to the spray drying process. The size of the particles produced is influenced by air temperature, nozzle, and pressure during the spray drying process. Bulk density is the weight of dried powder per unit volume, and this is a critical factor for most spray drying operations since it determines the size (or fullness) of containers and influences the handling and shipping costs. Bulk density continuously monitored during the spray drying process. Increasing air-drying temperature or decreasing feed flow rate generally resulted in a decrease in bulk density, and there was a greater tendency for particles to be hollow (Wang et al., 2015). The results of the spray drying process will also affect the ability of particles to sink. Sink-ability is the sinking of agglomerates below the liquid surface (Ortega-rivas, 2005). Powder agglomeration is a process of particle size enlargement that is routinely utilized in the production of spray-dried dairy powders, whereby numerous individual primary particles are combined into cluster-like structures where individual primary particles may still be distinguished. Agglomeration has been shown to alter the powder physical and bulk-handling properties, ultimately increasing their flow-ability, by reducing the extent of interparticle interactions (e.g., van der Waals forces) occurring between individual powder particles (Hazlett et al., 2020).

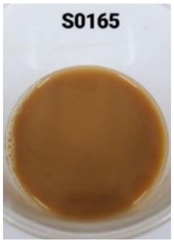
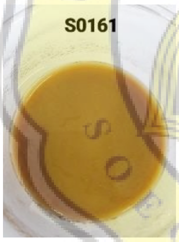
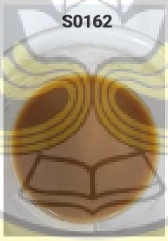
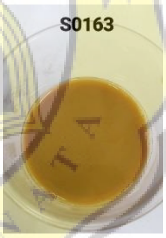
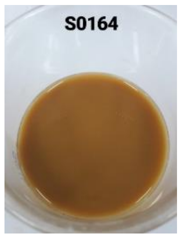
Coffee Test

In the coffee test, there are three parameters tested and can be seen at Table13. Firstly, the White Spot known as white dots as an undissolved component and it may cause by protein globule. The relative amount of protein present in the aqueous phase was not high enough to stabilize all fat droplets formed during homogenization (Tomas et al., 1994). White Flecks were particles that remains undissolved in a milk solution after reconstitution. The white flecks can also form a surface layer. They tend to be more prevalent when high total solids solutions were prepared (Ruíz, 2011). The white spot evaluation showed; not a single white spot was identified in every NDC sample, which means 'good' for all NDC samples. Only the S0161 sample had two white spots and could still be classified as useful. Therefore, the performance of NDC in the white spot was not affected much by the emulsifier's change.

Fatty eyes means little fatty balls are floating on the surface of the solution. The formation of fatty eyes is a sign of instability in the emulsion. Poor homogenization processes can influence fatty eyes. Fat globule size and membrane composition were affected by homogenization conditions.

The main effect of homogenization was the disruption of fat globules into smaller globules and, consequently, an increase of oil in water surface area (Tomas et al., 1994). High-pressure homogenization uses to produce these smaller droplets. A coarse emulsion of the ingredients is formed by blending, and this suspension is then passed through a homogenizing valve, at pressures which are generally in the region of 6.8-3.4 MPa (1000-5000 psi). This high-pressure flow through the valve creates turbulence, which pulls apart the oil droplets, during and after which the surfactant molecules adsorb to the newly created interface. Apart from the mechanical design of the homogenizer, the size of the emerging droplets depends on the factors, the homogenization pressure, the viscosity of the suspension, the number of passes, and the amount and types of surfactant present (Niels J. Krog, 2004). In the analysis of fatty eyes, all NDC samples had ethical values because none of the fatty eyes was detected. This shows that the process of homogenization of the emulsion is going well so that all fat droplets could be appropriately encapsulated, and all components are completely dissolved.

Table 18. Fatty Eyes Analysis

Ref	**S0161**	**S0162**	**S0163**	**S0164**
				

Sink ability means the time in second the coffee creamer needs to disappear below the surface of the coffee solution and should not exceed 12 seconds. The process sinking is started with particles fall below the surface of the liquid and begins the process of dissolution. Factors that can be affecting the sinking process are higher particle density, better sink ability; lactose crystallization also could increase sink ability, high-fat content, and less lactose crystallization. The particle density was also an influencing factor in sink ability in that the more massive the particle/unit volume, the more likely it is to sink. Thus, low interstitial air content was a prerequisite to good sink ability (Ruíz, 2011). Based on the analysis results, all NDC samples have quite good sink abilities, where the sink ability time recorded below 8 seconds, with the fastest time is 5 seconds, and the longest time is 7 seconds. This sink ability shows how the powder particle has been initially wetted and be able to sink into the water for complete dispersion and solubility.

4.3 Sensory Evaluation

Internal team

Sensory evaluation is useful for identifying a product's components and states the feasibility of a product based on an assessment that involves the human senses. According to the Handbook of Food Science and Technology, a sensory evaluation was a scientific method used to evoke, measure, analyze, and interpret those responses to products as perceived through the sense of sight, hearing, touch, smell, and taste (Nasir et al., 2017). Sensory evaluation conducted in this study aims to analyze whether there is a change in taste caused. Sensory evaluations carried out on three applications; 3in1 Coffee, White Coffee, and 10% solution. PT. Kievit also has a trained sensory team in Manila who will help clarify this sensory analysis validation.

In the 3 in 1 coffee application, the results from S0161 are slightly bitter, less creamy, and less milky. S0162 and S0163 have similar taste and mouthfeel characteristics. S0164 found a balanced sweet and bitter taste. It can be concluded that all four samples have insignificant differences from references. However, S0164 is the closes with the reference (S0165) following with S0163 and S0162.

White Coffee S0161 and S0162 applications have a stronger coffee taste and less creaminess. In S0163, a coffee flavor that is strong, milky, sweet, and visually has a brighter color. Unlike the others, S0164 has a coffee taste that is not strong, has a caramel, creamy, milky, sweet, and has a bright color flavor. Overall, S0161, S0162, S0163 are in the group and the most preferred sample.

In a 10% solution, S0161 gave a very different and less rounded taste than the other. S0162 to S0164 did not make a big difference, so it was assumed that all three had the same characteristics. It can be concluded that the differences between these five samples are not significant. However, S0164 is the closes with the reference.

Alaska Milk Corporation

From Table 17, it shows that there is no difference between reference and samples (S0161, S0162, S0163, S0164, S0165 and 60S) in the attribute for thin and brown appearance, coffee odor, coffee intensity, creamy, sweet and bitter taste, smooth mouthfeel and for the after taste of creamy and sour. Samples have a similar profile with reference in coffee application. No off note detected in each sample.