

## Instant Salam: an Instant Antidiarrheal Drink Based on Snedds of Salam Leaf Water Extract *Syzygium polyanthum* (Wight) Walp Against *Salmonella typhimurium*

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### ABSTRACT

**Keywords:**  
*Antidiarrheal;*  
*Bay Leaves;*  
*Instant Drink*  
*SNEDDS;*  
*Typhoid Fever;*

*Syzygium polyanthum* (Wight) Walp as known as bay leaves are traditionally used to treat various diseases such as diabetes mellitus, gastritis, ulcers, diarrhea, and skin diseases, but there is not enough research that discusses the benefits of this. This study aims to test the antidiarrheal content of instant drinks made from bay leaves as an alternative treatment for typhoid symptoms, reduce the reluctance of children and the elderly to take medication, reduce the risk of conventional antibiotic resistance that occurs due to continuous use of antibiotics, and utilize Indonesia's natural wealth as an alternative antibacterial agent accompanied by flexibility with the sophistication of the times, namely by the use of nanotechnology, one of which is called nanoemulsion. The manufacture of instant bay leaf nanoemulsion drinks involves a SNEDDS base solution that is homogenized with ultra turrax at 10,000 rpm for 30 minutes before being sonicated for 15 minutes at 40°C. The results showed that Salam Instant drink has antibacterial activity in the form of MIC of 0.781 mg/mL, MBC 0.156 mg/mL, DZI 1.775 ± 0.101 mm, inflammatory protection 76.04 ± 2.751%, antidiabetic 151.91 ± 4.8 IC<sub>50</sub> ug/mL. From the characterization of bay leaf SNEDDS, an average PSA of 680.057 ± 43.598 um, Zeta potential -5.08 ± 0.473 mV was obtained. Based on the results obtained, it can be concluded that SNEDDS-based bay leaf instant drink has antidiarrheal activity against diarrhea symptoms due to *Salmonella typhimurium* infection and has the potential to be used as an alternative medicine for diarrhea.

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### INTRODUCTION

In addition to creating a wealth of natural resources for human management, the tropical climate also creates the initial development of various infections in Indonesia, one of which is typhoid fever, or typhus. Typhus is a systemic infection caused by the *Salmonella typhimurium* bacteria and the infection spreads quickly through contaminated food or water or environments with poor sanitation (Suhaemi, 2010). Global data indicates that 11–20 million cases of typhoid occur annually with a mortality rate ranging from 128,000 to 161,000 people. Indonesia is among areas with a high proportion of typhoid populations, especially in the 3–19 age group, which accounts for 91% of all cases (Hendarta, 2014). Typhus symptoms appear after an incubation period of 1 to 3 weeks, including high fever, gastrointestinal disturbances, and malaise. In severe cases, it can cause fainting, vomiting, diarrhea, and abdominal discomfort (Zandroto & Situmorang, 2024).

The microbiota in the human digestive tract also influences diarrhea symptoms. Some good bacteria can prevent diarrhea, but bad bacteria such as *Escherichia coli* can trigger diarrhea. Medical treatment for typhoid generally uses antibiotics such as Azithromycin, Ceftriaxone, Chloramphenicol, and Ciprofloxacin. However, obstacles such as patient non-compliance in taking medication and concerns about side effects, as reported by the study by

Imami and Widhani (2024), indicate the need for more patient-friendly alternative treatments, especially for children and the elderly. Long-term consumption of conventional antibiotics has the potential to cause resistance to conventional antibiotics, so many researchers feel compelled to conduct research on natural ingredients as alternative antibacterial agents assisted by the sophistication of today's technology. The basic considerations in the development of pharmaceutical therapy technology consist of three main factors: creating an effective product (effectiveness), reducing harmful effects when used (safety), and so that it is well accepted by patients (acceptability) (Martien *et al.*, 2012). In recent years, several studies have explored the antibacterial potential of natural ingredients such as sea sponge extract (Rumampuk, 2017), honey (Santoso, 2020), pineapple (Yusliana, 2019), and bitter melon (Ulum, 2016). Of the many types of plants, one potential herbal plant that has not been widely explored is bay leaves (*Syzygium polyanthum*), which are known to contain active ingredients such as flavonoids, tannins, essential oils, and saponins that have antimicrobial properties. So far, several studies on the exploration of natural medicines have used bay leaves as the object of research and have produced satisfactory results, such as playing a role in lowering cholesterol levels (Yensasnidar & Marlinda, 2018), anti-inflammatory reactions (Agustina, Indrawati, & Masruhim, 2015), and also effective antibacterials against diarrhea symptoms (Evedi, 2017), thus providing the background for choosing bay leaves as an alternative typhoid medicine containing active ingredients that are considered useful in relieving diarrhea symptoms. Plant extracts have limitations in the form of low solubility, which also results in low bioavailability (Nazari-Vanani *et al.*, 2018). To increase the effectiveness of bay leaf active ingredients in treating diarrhea symptoms in typhoid, improvements in the microbiota in the human digestive tract are necessary, such as dietary changes and the use of probiotics containing beneficial bacteria.

Based on the above background, researchers want to conduct research focused on making probiotics in the form of instant drinks by applying a modern biotechnology approach formulated with SNEDDS. SNEDDS is a submicro-sized emulsion with a stable isotropic system where two liquids naturally do not mix with each other and form a homogeneous phase through the addition of surfactants with a nanodroplet colloidal system measuring less than 200 nm which is able to increase the bioavailability of active substances (Marwaha and Dabas, 2019), including the content of antibacterial compounds found in bay leaves which are the topic of the researcher's research. SNEDDS was chosen as an alternative formulation because of its various advantages in terms of stability, ease of applicability, and better lipophilic compound capacity compared to other lipid systems (Herneisey *et al.*, 2016). This study aims to develop SNEDDS-based instant drinks from bay leaves as an alternative therapy for *Salmonella typhimurium* infections with an analytical approach to the antidiarrheal activity test method (antibacterial, anti-inflammatory, antidiabetic), PSA, Zeta and SEM on SNEDDS-based instant drinks. It is hoped that this innovation will produce a product that is acceptable to both children and elderly patients, while providing effective therapeutic effects with minimal side effects. It will also significantly impact comfort and compliance with daily consumption. It also combines Indonesia's natural wealth with a nanotechnology approach, contributing to the development of modern, scientifically based herbal medicine.

The problem formulation in this study is to determine whether there is antidiarrheal activity in instant drinks made from bay leaves formulated with the SNEDDS system against *Salmonella typhimurium* bacteria. In line with the formulation of the problem, the aim of this study was to identify and analyze the antidiarrheal activity of SNEDDS-based bay leaf instant drink against *Salmonella typhimurium* bacteria.

## **METHOD**

### **Time and Place of Research**

This research was conducted from June to September 2025 at the Research Laboratory, Faculty of Medicine and Health Sciences, Kristen Krida Wacana University, Jakarta.

### **Tools and materials**

Beaker Glass, Analytical scale, UV-Vis spectrophotometer (BioChrom Libra S-22), Magnetic stirrer, Sonication, Centrifuge, Micropipette, Waterbath, Rotary evaporator, 1.5 mL tube, Hot plate, Microscope, Maceration vessel, Blender, Freeze dryer, Mortar, Polypropylene tube, Tissue Tex Processor, microtome, oven, glass bath, glass object, cover glass, Particle size analyzer, vortex homogenization. Bay leaves, oleic acid, PEG 400, distilled water, maltodextrin surfactant (tween 80).

## **Research Design and Procedures**

### **Sampling and Processing**

Bay leaves were selected using the purposive sampling method, then cleaned and dried with a food dehydrator to produce dried bay leaf simplicia. Simplicia is blended into powder form before it is ready to be decocted.

### **Extraction**

Leaf simplicia about 500 mg were dissolved in 1 L of water and decocted until 200 mL remained using a hot plate and magnetic stirrer to be water extract. Water extract processed in freeze dryer to be powdered form.

### **Phytochemistry Test**

#### **Phenolic Content**

Phenolic content was determined using the Folin-Ciocalteu method, which involved mixing 500 mL of bay leaf water extract with 2500 mL of Folin-Ciocalteu reagent, stirring until homogeneous and letting it stand for 10 minutes, then adding 2500 mL of 2M Na<sub>2</sub>CO<sub>3</sub> solution and mixing until homogeneous. The solution was allowed to stand for 2 hours in a dark place. Absorbance was measured using a UV-Vis Biochrom Libra S-22 spectrophotometer at a wavelength of 765 nm.

#### **Flavonoid Content**

Bay leaf extract of about 500 µl was added to 150 µl of 10% AlCl<sub>3</sub>, 150 µl of 5% NaNO<sub>2</sub> and 2 mL 1M NaOH. This solution was incubated in 15 minutes at RT and evaluated at 510 nm with a UV-Vis Biochrom Libra S-22 spectrophotometer.

### **Preparation of SNEDDS Bay Leaf Extract**

Oleic acid, Tween 80 and PEG 400 are mixed in a ratio of 1:8:1 to make the first mixture, which is the oil phase. The second mixture content is 125 mg bay leaf water extract. The two mixtures were then mixed and distilled water was added. The solution was then homogenized with Ultra Turrax at 10,000 rpm for 30 minutes.

### **Bioactivity Test**

#### **Antibacterial activity**

This test was carried out using the well diffusion and microdilution method. Before the antibacterial activity test was carried out, *Salmonella typhimurium* bacteria had been pure cultured in Luria Bertani Agar (LBA) OXOID CM1116 media. Ciprofloxacin was used as positive control antibiotics. Amount of 50 µl 0.5 McFarland suspension containing *Salmonella typhimurium* were inoculated in MHA with sterile swab. Cork borer set no.2 was used to create a well on the surface of MHA. An amount of 40 µl bay leaf water extract, SNEDDS and ciprofloxacin was added in a separate well. Next step, petri dishes were incubated in an incubator with 37°C in 24 hours. Inhibition zone were determined with a clear zone surrounding the well.

Microdilution method was performed with 96-well to determine MIC and MBC of bay leaf water extract and SNEDDS. This method used MHB as a medium, incubation time 24 h at 37°C. MIC value is determined by the white dot in the bottom of the microtiter well at the lowest concentration.

#### **Anti-inflammatory**

Anti-inflammatory testing of bay leaf water extract, SNEDDS preparation of bay leaf water extract and diclofenac sodium using heat-induced hemolysis of human red blood cells (HRBC). Fresh blood samples of 3 mL were taken by professional medical personnel and pipetted into a heparin tube, then centrifuged for 10 minutes at 3000 rpm. After that, the red

blood cells were resuspended using a saline solution with the same volume as supernatant volume and re-dissolved as a 40% suspension with 10 mM sodium phosphate buffer (pH 7.4). The buffer solution consisted of NaH<sub>2</sub>PO<sub>4</sub> (0.2 g), Na<sub>2</sub>HPO<sub>4</sub> (1.15 g) and NaCl (9 g) in 1 L of distilled water. The phosphate buffer will be used to prepare dilution groups for treatment group 1 of bay leaf water extract, treatment group 2 of SNEDDS preparation of bay leaf with water extract and diclofenac sodium as a negative control. Three centrifuge tubes were prepared, each containing 5 mL of sample, 4.85 mL of isotonic buffer solution, and 0.15 mL of 40% red blood cell suspension. Each group was incubated for 20 minutes in a water bath at a temperature of 54°C, while the other group was placed in the refrigerator. After that, the tube will be centrifuged for 7 minutes at a speed of 3500 rpm, then the absorbance of the supernatant was measured using a UV-Vis spectrophotometer with a wavelength of 560 nm. This test was carried out 3-5 times.

The percentage of membrane stability is calculated as follows:

$$\text{Protection percentage (\%)} = \left[ 1 - \frac{A_2 - A_1}{A_3 - A_1} \right] \times 100$$

A1 = Unheated sample absorbance

A2 = Absorbance of heated sample

A3 = Heated control absorbance

### Antidiabetic

The antidiabetic test was conducted based on  $\alpha$ -glucosidase inhibition. The  $\alpha$ -glucosidase inhibitory activity of the extract and acarbose was determined using  $\alpha$ -glucosidase from *Saccharomyces cerevisiae* (EC 3.2.2.20) and p-nitrophenyl- $\alpha$ -D-glucopyranoside (pNPG) as the substrate. A total of 50  $\mu$ L of sample solutions with various concentrations will be mixed with phosphate buffer pH 6.8 (50 mM, 50  $\mu$ L). Then  $\alpha$ -glucosidase solution (0.5 U/mL, 50  $\mu$ L) was added, and the reaction mixture will be incubated first at 37°C for 5 minutes. Then, pNPG (1 mM, 100  $\mu$ L) will be added, and the reaction mixture will be incubated again at 37°C for 20 minutes. The reaction was stopped by the addition of Na<sub>2</sub>CO<sub>3</sub> (100 mM, 750  $\mu$ L), and the absorbance was read at 405 nm. Acarbose was used as a positive control. The percentage of inhibition was calculated as follows:

$$\alpha - \text{glucosidase inhibition (\%)} = \frac{A_{\text{control}} - A_{\text{sample}}}{A_{\text{control}}} \times 100$$

Control & sample A = Negative absorbance of control and sample

Then, IC<sub>50</sub> will be calculated using the linear regression equation obtained from the plot of % inhibition against concentration.

#### 1. SNEDDS Characterization Test of Bay Leaf Water Extract

##### a. Particle Size

The particle size of the SNEDDS Bay Leaf Water Extract preparation was measured using a particle size analyzer. The sample was dispersed in distilled water to a volume of 5-10 mL, then the sample was placed in a cuvette and was analyzed. Particle size is the most important characteristic in a nanoparticles system because it directly affects the unique properties of the nanoparticles.

##### b. Zeta Potential Value

The zeta potential value was also measured using a particle size analyzer using samples diluted with distilled water to an equal volume. A dip cell electrode was used to cover the cuvette prior to analysis. This method was used to ensure accurate zeta potential values (Fitri et al., 2019).

##### c. Scanning Electron Microscope Photograph

SNEDDS Preparation of Bay Leaf Water Extract before being observed at various magnification levels, the sample will be coated with copper in vacuum via cathode sputtering and then observed using a scanning electron microscope (SEM) with an accelerating voltage of 20 kV.

## 2. Making Instant Drinks (Instant Salam) with SNEDDS Bay Leaf Extract

SNEDDS Preparation of Bay Leaf Water Extract was added with sugar and changed until it looked like a fine powder that can dissolve in water using a freeze dryer.

### Data Processing and Analysis

Data processing in experimental research is obtained from various data sources as follows:

1. Phytochemical tests include flavonoids and phenolics
2. Activity tests include antibacterial, anti-inflammatory, and antidiabetic
3. Characterization tests include particle size, zeta potential and SEM of SNEDDS preparations of bay leaf water extract.
4. Data normality test using the Shapiro-Wilk test in STATA statistical software

Data analysis in this experimental study included phytochemical tests of compounds that play a key role in the activity of bay leaves, flavonoids and phenolics. Particle size characterization tests were required to determine nanoparticles size, zeta potential was used to assess stability, and SEM was used to photograph the results.

## RESULT AND DISCUSSION

### Characterization of Extract and SNEDDS

#### Uv-vis spectrophotometric spectrum of bay leaf extract

The image below shows peaks at wavelengths of 229 and 270 nm, indicating the presence of two dominant compounds. These two dominant compounds are related to the solvent used and the extraction method, which in this study were water and decoction. In Khoiriyah's research (2023), it was found that the decoction method extracts similar compounds, including phenolics, terpenoids, and triterpenoids, while the maceration and soxhlation methods extract similar compounds, including flavonoids, terpenoids, triterpenoids, phenolics, coumarins, and anthraquinones.

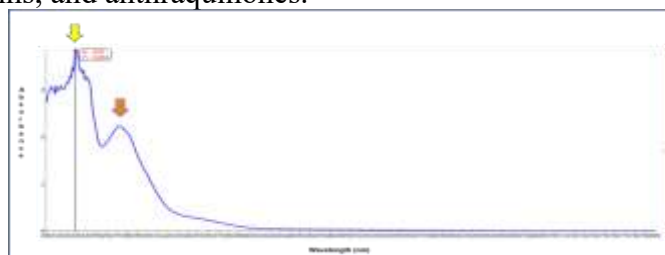


Figure 1. Spectrum of Bay Leaf Extract

### Total Phenolic and Flavonoid Content

In the table below it is written that the Total Phenolic Content (TPC) level is 856.1 mg Gallic acid equivalent / dry weight. This level is high compared to the level of bay leaf stem cortex using ethanol extract in Nurjanah's research (2017), it showed a much higher total phenolic content, which is around 366.95 mg GAE / g extract. Meanwhile, the flavonoid content of  $1,653 \pm 0.0594$  is classified as quite low to moderate. Besides extraction methods and solvents, flavonoid content is also influenced by environmental conditions and the developmental stage of the plant (Zou, K, et al. 2019).

Table 1. TPC and TFC Results

	Total Phenolic Content (mg GAE/g dried biomass)	Total Flavonoid Content (mgRE/g dried biomass)
Bay Leaf Water Extract	856.1	$1.653 \pm 0.0594$

### Antibacterial Activity

Bay leaf extract, SNEDDS bay leaf water extract and ciprofloxacin antibiotic were tested for antibacterial activity using gram-negative bacteria, namely *Salmonella typhimurium*

by finding DIZ, MIC, and MBC. The results are presented in Tables 2 and 3. In Figure 2, an inhibition zone can be observed around the three treatment groups, indicating antibacterial activity against *Salmonella typhimurium*.



Figure 2. Antibacterial Disc Diffusion

Top = Ciprofloxacin Antibiotic  
 Right = Conventional extract  
 Left = SNEDDS Bay Leaf Water Extract

It can be seen that around the 3 groups there is a clear zone which is the inhibition zone. Some of the compounds in bay leaves that have the most effect on the antibacterial of *Salmonella typhimurium* are flavonoids and phenolics. The mechanism of action of flavonoids on bacteria is to bind bacterial cell proteins through hydrogen bonds to form complex compounds causing the rupture of the cell wall structure and the cytoplasmic membrane of bacteria so that bacterial cells are damaged (Akroum et al., 2009 in Mamay, et al. 2018). Meanwhile, the mechanism of action of phenolic compounds on bacteria is by damaging the cell wall and damaging the enzymes in bacteria.

Although the 3 groups provide a direct effect for antibacterial, to get clear and optimal results as in the picture above, it takes <5 hours for antibiotics and >5 hours for conventional bay leaf extract and bay leaf SNEDDS concentration of 500 mg/mL in an incubator.



Figure 3. Microdilution for MIC Determination

Antibacterial activity was further evaluated by determining MIC and MBC values in Table 2 and inhibition zone diameter in Table 3.

**Table 2. MIC and MBC results**

	Mean MIC (mg/mL)	Mean MBC (mg/mL)
Bay Leaf Water Extract	0.3125	1.25
SNEDDS Bay Leaf Water Extract	0.078125	0.15625
Ciprofloxacin	0,01	0,02

**Table 3. DZI results of the Shapiro - Wilk normality test**

Group	Inhibition Zone Diameter		p-value
	Average	SD	
Bay Leaf Water Extract 20 mg/ml	1,2908	0.056	> 0.05
SNEDDS Bay Leaf Water Extract 20mg/ml	1,7554	0.101	> 0.05
Ciprofloxacin 20 ug/ml	3,0672	0.020	> 0.05

Ciprofloxacin antibiotic showed the most significant antibacterial activity against the tested bacteria. It can be seen in the table presented that SNEDDS bay leaves have smaller numbers for MBC and MIC, and larger numbers for DZI on average at 1.7554, while the average in conventional extracts is 1.2908. According to Makadia et al., (2013) these results

are supported because bay leaf extract has a low solubility level so that bay leaf extract made into a Self Nanoemulsifying Drug Delivery System (SNEDDS) preparation can increase effectiveness, solubility and bioavailability so that drug delivery is more optimal.

#### Anti-inflammatory Activity

Bay leaf water extract, bay leaf SNEDDS and non-steroidal drug sodium diclofenac were measured using UV-Vis spectrophotometry and using red blood cells, determining the protection of 20 mg/ml of each ingredient. The results are presented in Table 4.

**Table 4.** Results of the Shapiro-Wilk Protection Normality Test

Group	Protection (%)		p-value
	Average	SD	
Conventional Extract 20 mg/ml	63.99	1.11993	> 0.05
SNEDDS Bay Leaf Water Extract 20mg/ml	76.04	2.75118	> 0.05
Diclofenac Sodium 20 ug/ml	88.79	0.29091	> 0.05

Diclofenac sodium has the highest average protection of 88.794 with the lowest SD of 0.290912358. While bay leaf SNEDDS has an average protection of 76.038 along with the highest SD value of 2.751176112. And bay leaf water extract has an average protection with the lowest value. Although the protection of SNEDDS Bay leaf water extract is still lower than diclofenac sodium, it has been proven to have a fairly effective anti-inflammatory effect. Diclofenac sodium has a mechanism to prevent protein denaturation at pathological pH 6.2-6.5. In addition, diclofenac sodium can inhibit the cyclooxygenase enzyme (Rahmawati et al., 2020 in Trinovitasari, et al. 2025). Based on research by Risna Agustina, et al. (2015), it was stated that the anti-inflammatory activity of flavonoid compounds in bay leaf extract is thought to be related to the inhibition of cyclooxygenase formation in the arachidonic acid metabolic pathway.

#### Antidiabetic Activity

In the antidiabetic test, the  $\alpha$ -glucosidase enzyme was tested by the sample. In Table 5, the average IC<sub>50</sub> SNEDDS results for bay leaves were 151.91 and for bay leaf water extract was 558.15. The smaller the IC<sub>50</sub> reading, the greater the antidiabetic activity and vice versa. One of the compounds that play an important role in antidiabetic activity are flavonoids and phenolics.

**Table 5.** IC<sub>50</sub> Leaf extract and SNEDDS against alpha glucosidase

	IC <sub>50</sub>	
	Average	SD
Bay Leaf Water Extract	558.15	13.04
SNEDDS Bay Leaf Water Extract	151.91	4.8

Flavonoid compounds are known to have the potential to inhibit the activity of the  $\alpha$ -glucosidase enzyme. Flavonoid compounds are known to activate adiponectin. In a study by Azzahra et al. (2025), it was stated that type 2 diabetes mellitus patients have little adiponectin which plays an important role in improving the balance of insulin and blood glucose. Flavonoids are hypoglycemic because they can inhibit the glycolysis activity of brush border enzymes. Then flavonoids can stimulate lipogenesis and glucose transport so that they can lower blood glucose levels (Dalimartha & Adrian, 2012 in Azzahra et al. 2025). Additionally, the flavonoids contained in bay leaves are a class of antioxidant compounds that can prevent degenerative diseases and reduce oxidative stress caused by aging in cells of organs and systems in the body. Flavonoids work by inhibiting damage to  $\beta$  cells in the pancreatic islets of Langerhans (Lajuck, 2012 in Azzahra et al., 2025). In addition, flavonoid compounds are known to be able to capture free radicals (ROS/Reactive Oxygen Species or RNS/Reactive Nitrogen Species) through electron transfer, as well as inhibit peroxidation reactions (Lugasi, Hovari, Sagi, & Biro, 2003 in Hikmah, et al. 2016). Phenolic compounds in bay leaves such as

3,4,5-trihydroxy benzoic acid, 4-hydroxy 3-methoxy benzoic acid, and 4-hydroxy-3,5-dimethoxy benzoic acid act as antioxidants (Lelono & Tachibana, 2013 in Hikmah, et al. 2016).

### SNEDDS Characterization Test of Bay Leaves PSA, and Zeta potential

A particle size of a SNEDDS is usually expressed as the diameter of the globules in the internal phase (Mohanraj and Chen, 2005 in Rusdi, 2010). The Psa results are shown in Table 6.

**Table 6.** SNEDDS results of Bay Leaf Water Extract PSA, and Zeta potential

Characterization	SNEDDS Bay Leaf Water Extract						
	1	2	3	4	5	Average	SD
<b>PSA</b>	656,253	702,639	693,869	729,693	617,831	680,057	43.598
<b>Zeta Potential</b>	-4.75	-5.89	-5.04	-4.73	-4.99	-5.08	0.473

The average particle size is 680.057. In the results of the SNEDDS research on natural dyes from sappan wood (*Caesalpinia sappan L.*) extract, particle size measurements showed that a single formulation using Tween emulsifier and a double formulation using a combination of Tween-Tween produced a SNEDDS formula with a larger particle size diameter (>100 nm) of 254.7 nm. Particle size depends on the type and percentage of emulsifier and the addition of additional substances, if the particle size of the internal phase is smaller, the SNEDDS system becomes more stable and strengthened (Tan and Nakajima, 2005 in Rusdi, 2010). Other factors that influence particle size include the ratio of the oil phase and the water phase, the type and percentage of emulsifier. In general, SNEDDS tends to have a larger size compared to nanoparticles, because SNEDDS itself is a combination of 2 phases. Meanwhile, the zeta potential value is at an average of -5.08, the results are shown in table 6. A favorable zeta potential value indicates that the preparation formulation has a high zeta potential value, this can prevent aggregation which will cause the stability of the preparation to be more stable (Nugroho and Sari, 2018). The range of zeta potential values that can predict the storage stability of the preparation is, a zeta potential value greater than 30mV and less than -30mV indicates that the preparation has good electrostatic stability, 5-15mV indicates limited flocculation, and 3-5mV indicates maximum flocculation (Heurtault, 2003 in Handayani, et al., 2018). Then for the surfactant tween 80 which is a nonionic surfactant so it can help stabilize SNEDDS.

### SEM

It can be seen in the image below that the particle shapes are non-uniform, this can be related to the particle measurements via PSA which exhibited very high standard deviation. Therefore, optimization of the SNEDDS preparation process is required.

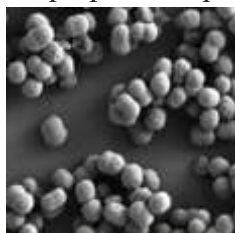


Figure 4. result of SEM

### Salam Instan Instant Drink Results

The image below shows the freeze -dried powder creating a white and pale cream in color. The resulting powder has a fragrant and moderately sweet aroma.



Figure 5. results of instant drinks

## CONCLUSION

Salam Instan drink demonstrates antidiarrheal activity against *Salmonella typhimurium*. The antibacterial effect is primarily attributed to the presence of flavonoid and phenolic compounds, although its effectiveness remains lower than Ciprofloxacin, with a difference of 42.81%. Salam Instan exhibits anti-inflammatory activity with a difference of 12.74% compared to diclofenac sodium, indicating its potential to alleviate inflammatory symptoms associated with typhoid. Furthermore, in terms of antidiabetic activity, the SNEDDS-based formulation of bay leaves shows that Salam Instan has a 72.78% lower activity compared to bay leaf extract, where a lower IC50 value reflects better antidiabetic effectiveness. These findings suggest that Salam Instan possesses promising pharmacological potential, although its efficacy is still comparatively lower than standard pharmaceutical agents. For future research, it is recommended to optimize the SNEDDS preparation process, as the SEM images reveal a non-uniform particle shapes and PSA measurements create a very high standard deviation. Moreover, methods should be explored to increase the MIC and MBC of Salam Instan, thus enhancing inhibition of *Salmonella typhimurium* motility.

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