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Telang Flower Infusion Reduces Inflammation and Increases Goblet Cells in Infection Salmonella typhimurium Models

Rian Anggia Destiawan[1]*, Delvia Asista Indarusanti[2], Ahdiah Imroatul Muflihah[3], Anas Fadli Wijaya[4]
[1,2,3,4] Medical Laboratory Technology, Faculty of Health Sciences, University of dr. Soebandi

***Correspondence author** : rianad@uds.ac.id

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ABSTRACT

Salmonella enterica serovar typhimurium is a gram-negative bacterium that causes infection in the digestive tract. This infection leads elevation in inflammatory cells and a reduction in goblet cells. Telang flower infusion contains antioxidants that have anti-inflammatory and tissue repair potential. This research aimed to evaluate the effect of butterfly pea flower infusion for decreasing of inflammatory cells and increasing of goblet cells in mice infected with S. typhimurium. The methods of this study were the manufacture of telang flower infusion, Salmonella typhimurium bacterial infection 1.5x10^{8} cfu, grouping of mice in negative, positive (only infected), Brand S (0.25 ml/20 gBW), treatment 1 (0.25 ml/20 gBW), treatment 2 (0.5 ml/20 gBW), and treatment 3 (1 ml/20 gBW), histology of colon, and data analysis using Kruskal-Wallis ($p<0.05$). The results showed that the average inflammatory cells in the negative was 1.25+0.5, the positive 1.5+1, Brand S 0.75+0.5, treatment 1 1.25±0.96, treatment 2 1.25±0.5, and treatment 3 2±1.15. Kruskal-Wallis analysis, it was shown that there was no significant difference between the groups (0.54>0.05). The average goblet cells in the negative group were 25.1±2.29, positive 21.2±8.34, Brand S 44.2±19.52, treatment 1 27.9±8.63, treatment 2 32.4±10.13, and treatment 3 22.2±15.04. Kruskal-Wallis analysis showed that there was no significant difference between groups (0.27>0.05). However, biologically, there are differences between groups. This study concludes that a dose of 0.5ml/20 gBW is a dose that is able to reduce inflammatory cells and increase the number of goblet cells.

Keyword: Typhoid fever; S. typhimurium; Colon; Telang flower

ABSTRAK

Salmonella enterica serovar typhimurium adalah bakteri gram negatif yang menginfeksi pencernaan. Infeksi ini menyebabkan peningkatan sel inflamasi dan penurunan sel goblet. Infusa bunga telang mengandung antioksidan yang memliki potensi anti-inflamasi dan perbaikan jaringan. Tujuan dari penelitian ini adalah untuk mengetahui efek infusa bunga telang terhadap penurunan sel inflamasi dan peningkatan sel goblet pada tikus yang terinfeksi S. typhimurium. Metode penelitian ini adalah pembuatan infusa bunga telang, infeksi bakteri Salmonella typhimurium 1,5x10^{8} cfu, pengelompokan mencit kelompok negatif, positif (hanya terinfeksi), Merk S (dosis 0,25 ml/20 gBB), perlakuan 1 (dosis 0,25 ml/20 gBB), perlakuan 2 (dosis 0,5 ml/20 gBB), dan perlakuan 3 (dosis 1 ml/20 gBB), histologi organ kolon, dan analisis data menggunakan Kruskal-Wallis (p<0,05). Hasil dari penelitian menujukkan bahwa rata-rata sel inflamasi pada kelompok negatif 1,25+0,5, kelompok positif 1,5+1, Kelompok Merk S 0,75+0,5, kelompok perlakuan 1 1.25±0.96, kelompok perlakuan 2 1.25±0.5, Kelompok perlakuan 3 2±1.15. Berdasarkan analisa Kruskal-Wallis menunjukkan tidak ada perbedaan yang signifikan antar kelompok (0,54>0,05). Rata rata sel goblet pada kelompok negatif yaitu 25.1±2.29, positif 21.2±8.34, Merk S 44.2±19.52, perlakuan 1 27.9±8.63, perlakuan 2 32.4±10.13, dan perlakuan 3 22.2±15.04. Berdasarkan analisis Kruskal-Wallis menujukkan tidak ada perbedaan yang signifikan antar kelompok (0,27>0,05). Namun secara biologi, terjadi perbedaan antar kelompok. Kesimpulan penelitian ini adalah dosis 0,5ml/20 gBB merupakan dosis yang mampu mengurangi sel inflamasi dan meningkatkan jumlah sel goblet.

Kata Kunci: *Demam tifoid; S. typhimurium; kolon; Bunga Telang*

*Correspondence author: rianad@uds.ac.id

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Introduction:

Typhoid fever is an infectious disease that is familiar to people in developing countries. The disease is caused by *Salmonella Sp* bacteria, with occasional contamination through food or drink (Marsa *et al*., 2020) Typhoid fever is found worldwide, and its prevalence is considered high in developing countries, especially in the tropics (Khairunnisa *et al*., 2020). Globally, typhoid fever cases (typhoid and paratyphoid combined) are estimated at 9.3 million cases, and the death rate in 2021 is estimated at 107,500 (range between 56,100-180,800) (Piovani *et al*., 2024). National data based on data from the Ministry of Health in 2023 shows that in 2020, there were 317,000 cases, in 2021, there was an increase of 561,000 cases, and then in 2022, there was another increase of 736,000. This increase shows that Indonesia is still the largest contributor to typhoid fever cases (Budi *et al.*, 2024). Typhoid fever is caused by several Salmonella variants, including *Salmonella cholerae, Salmonella paratyphi A, and Salmonella paratyphi B*. *Salmonella typhi* is generally found in the blood and feces of people suffering from typhoid fever (Prasetia *et al*., 2019).

Clinical symptoms of typhoid fever that are often found are fever and diarrhea. Fever complaints generally occur in the afternoon or evening. Sustained fever is a characteristic of typhoid fever, which is also commonly known as a gradual increase in body temperature (Khairunnisa *et al*., 2020). Several types of typhoid fever cases can be assessed from the location of local conditions and the lifestyle of the community. *Salmonella typhimurium* bacteria in humans enter the body orally through contaminated food and drink, and can be transmitted through hands or other insects (Mustofa *et al*., 2020). *Salmonella typhimurium* can live in macrophages and, at the end of the disease, will cause several gastrointestinal symptoms. One of the effects of *Salmonella typhimurium* bacterial infection is increased goblet cell damage, resulting in increased inflammatory activation and increased Reactive Oxygen Species (ROS) levels (Hayati & Ikhsani, 2021).

Telang flower infusa has phytochemical compounds, including anthocyanin pigments and flavonoids. Anthocyanin pigments function to prevent inflammation, thus optimizing the innate immune response. In addition, flavonoids function as anti-inflammatory agents that can reduce inflammatory cell infiltration and contain high antioxidant compounds. Antioxidants help protect the body from cell damage caused by free radicals, thus preventing and regenerating damaged cells (Yurisna et al., 2022). Previous research has shown that black grape extract can increase CD4+ T lymphocytes at low doses and decrease CD4+ T lymphocytes at high doses in the *Salmonella typhimurium* infection model mice (Destiawan *et al*., 2023), In addition, the effect of telang flower infusion can also increase the number of neutrophils and lymphocytes in mice infected with *Salmonella typhimurium* bacteria (Anggia Destiawan *et al*., 2024). The novelty of this study is the use of telang flower infusion, which has flavonoid compounds that act as antioxidants that can reduce inflammatory cells in colon tissue and repair/prevent goblet cell damage. This research aimed to evaluate the effect of butterfly pea flower infusion on the decrease of inflammatory cells and the increase of goblet cells in mice infected with S. typhimurium.

Methods:

***Telang Flower* Infusion**

Dried telang flowers are blended until smooth. Telang flower powder is then weighed at 100 grams. The powder that has been weighed is then added to 1000 mL sterile distilled water solvent in an Erlenmeyer tube, in a ratio of 1:10. Then the solution is homogenized and heated with a Bunsen flame for 15 minutes at a temperature of 75-90. To see the required temperature, insert the mercury thermometer into the solution. The solution is then continued to the filtration stage using a paper filter. The solution is then continued with the filtering stage using filter paper (Arifah, 2024).

Preparation of *S. typhimurium* Bacterial Suspension

S. typhimurium bacterial suspension obtained from Universitas Brawijaya, Malang.

Before making the bacterial suspension, the McFarland standard is made, which is used as a reference to adjust the turbidity of the bacterial suspension so that the number of bacteria is in the same range. The McFarland standard in this study uses a scale of 0.5 with a bacterial concentration of 1.5 x 10^8. The procedure for making McFarland standards includes using 1% $BaCl_2$ and 1% H_2SO_4 in a ratio of 1:$BaCl_2$ was pipetted as much as 0.05 ml or 50 μL, and H_2SO_4 was added as much as 9.95 ml, vortexed, and the test tube was closed using cotton covered with aluminum foil. The McFarland standard is placed in a dark place and protected from sunlight (Rizki Febrianti *et al.*, 2020).

The method of making McFarland bacterial suspension is to add 10 ml of sterile distilled water to a test tube and then mix it with the bacterial culture taken using a ose. Then homogenized until the color of turbidity was the same as the McFarland standard that had been made (Zahara *et al.*, 2022)

Grouping of Mice

Grouping: The purpose of the grouping was to find out the difference in responses in mice that were not given therapy and mice that were given Telang Flower infusion therapy. Grouping includes negative groups (without treatment), positive groups (given distilled water), Merk S groups (0.25 ml/20 gBW), treatment group 1 (P1) (telang flowers infusa dose of 0.25 ml/20 gBW), treatment group 2 (P2) (telang flowers infusa dose of 0.5 ml/20 gBW), treatment group 3 (P3), (telang flowers infusa dose of 1 ml/20 gBW). The ethical clearance of this research is from Universitas dr. Soebandi with ethical number No. 439/KEPK/UDS/VI/2024.

Induction of *Salmonella typhimurium* Bacteria

The infection of *Salmonella typhimurium* bacteria was induced through intraperitoneal injection at a concentration of 1.5x10^8 cfu in a volume of 0.2 mL. The mice were then evaluated using blood smears stained with Gram stain to identify the presence of bacteria in the bloodstream.

***S. typhimurium* Bacteria Examination**

Confirmation test after infection with *S. typhimurium* bacteria on day 3, a confirmation test in the form of Gram staining, which aims to see the presence or absence of bacteria in the blood circulation. Blood sampling through the tip of the mice's tail is cut using surgical scissors about 1 mm, then the tail is sorted to remove blood and placed on a glass object, and a blood smear is made. Wait until the glass object dries, and after that, Gram staining is carried out, and bacterial observations are made using a microscope. At 100x magnification using an objective lens.

Telang Flower Infusion Therapy

After confirming the presence of bacteria, telang flower infusion therapy was administered to the mice according to the designated treatment groups: a negative control group (without treatment), a positive control group (*Salmonella typhimurium* infection), the Merk S group (0.25 mL/20 g BW), treatment group 1 (0.25 mL/20 g BW), treatment group 2 (0.5 mL/20 g BW), and treatment group 3 (1 mL/20 g BW). The therapy was given for 7 consecutive days at the predetermined doses.

Tissue Necropsy and Staining

Mice are dissected to obtain the colon organs, taking the intestinal organs in the form of a colon section. The colon is taken and washed using 0.9% physiological NaCl to a clean solution, then soaked using 10% Neutral Buffer Formalin for further tissue histological processes. The organ is cut into pieces of about 1 cm and placed on top of paraffin blocks to go through the tissue processing stage. Then, histological preparations were made using Eosin hematoxylin staining.

Examination of Inflammatory Cells and Goblet Cells

Observation of inflammatory cells and goblet cells is performed using a microscope with a magnification of 40x using an objective lens. Inflammatory cells use a scoring classification (Table 1), and Goblet cell observations were made in 5 fields of view and counted with 40x

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magnification, then the results were averaged. Then, to see the significant difference, a statistical analysis was carried out using the Kruskal-Wallis test with a significance value ($p<0.05$).

Table 1. Scoring of Inflammatory Cells in the Colon

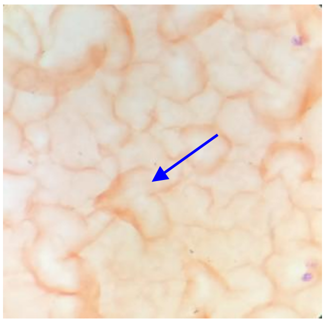
No	Score	Description
1	1	Inflammatory cells are located in the mucosa
2	2	Inflammatory cells are located in the mucosa and submucosa
3	3	Inflammatory cells are transmural or spread

Results:

Infection is a disease caused by microorganisms that enter and multiply in organs, such as bacteria. Infections can occur when there is interaction with bacteria that can cause several symptoms and clinical signs. Bacterial infections can cause inflammation. Based on the examination of blood smears, it showed that *Salmonella typhimurium* bacteria were found in the blood circulation (bacteremia), the morphology of the bacteria was gram-negative and rod-shaped.

Salmonella typhimurium is one of the enteric serovar bacteria that attack the gastrointestinal area. The bacteria are Gram-negative and rod-shaped. *Salmonella typhimurium* bacteria are also invasive, one of which is bacteremia/bacteria found in the blood (Zizza *et al*., 2025).

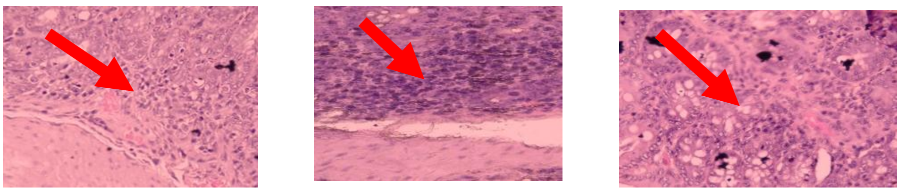
Discussion :



Examination of bacteria in blood vessels is shown in **Figure 1**. There are bacteria in the blood circulation (blue arrow sign) that indicate *Salmonella typhimurium* bacteria have bacteremia properties.

Inflammatory cell examination

Inflammation is a protective response of innate immune cells to fight microorganisms, one of which is bacteria. Inflammatory mechanisms can occur when inflammatory cells fight bacteria. Bacterial infection can cause damage to goblet cells (**Figure 4; Figure 5**) and induce inflammatory cells (**Figure 2; Figure 3**). Increased inflammatory cells can increase ROS, causing cell damage. In acute conditions, cell damage will occur, which causes an increase in ROS. In the endothelium, TLR4 signaling affects the increase in ROS production and activates the transcription factor NFkB, thereby increasing the production of inflammatory mediators. Inflammatory cells that play a role in fighting bacteria in tissues, one of which is neutrophils. Neutrophils are polymorphonuclear cells that have 3-5 lobes and play an important role in the formation of inflammatory processes in tissues (Patel *et al*., 2021).



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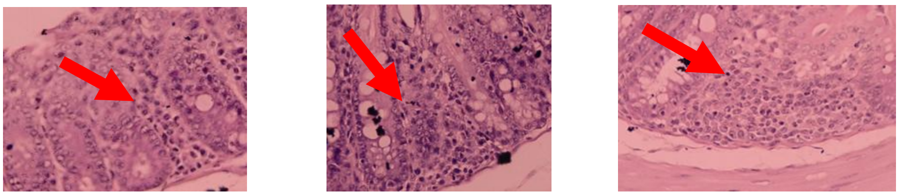
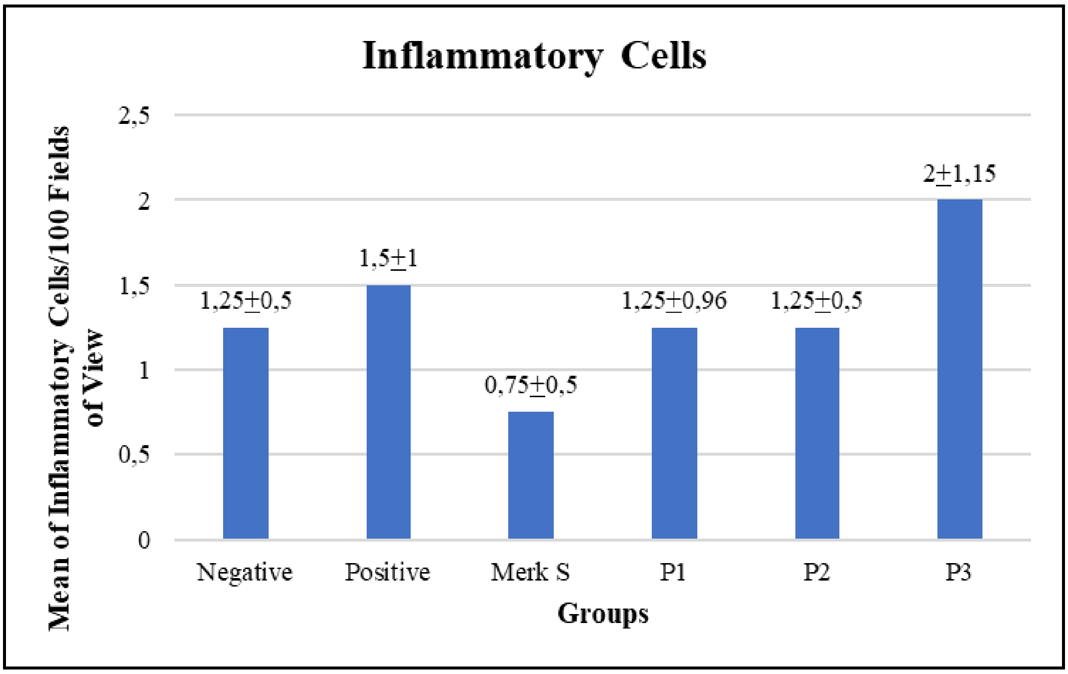


D E F

Examination of the infiltration of inflammatory cells in the colon tissue shows in **Figure 2**. (A) negative control group, (B) positive control group, (C) Merk S group, (D) infusion of telang flower at a dose of 0.25 ml/20 gBW, (E) infusion of telang flower at a dose of 0.5 ml/20 gBW, (F) infusion of telang flower at a dose of 1 ml/20 gBW. 400x magnification.



The mean of inflammatory cells (/100 field of view) from each groups show in **Figure 3**

Group 1, the healthy treatment or negative control (K-), which was not given treatment, had an average score of 1.25 ± 0.5, which was characterized by the presence of inflammatory cells that spread in the mucosal area of the colon tissue (**Figure 2A**). Group 2, the positive control group (K+), which was infected with *Salmonella typhimurium* bacteria and only given aquadest, had an average score of 1.5 ± 1, which was characterized by the presence of inflammatory cells in the mucosal area (**Figure 2B**). Group 3, which is the Merk S group infected with *Salmonella typhimurium* bacteria and given Merk S, has an average score of 0.75 ± 0.5, which is characterized by inflammatory cell infiltration in the mucosa (**Figure 2C**).

Group 4, namely treatment group 1, which was infected with *Salmonella typhimurium* bacteria and given an infusion of telang flowers at a dose of 0.25 ml/20 gBW, had an average score of 1.25 ± 0.96, which was characterized by the presence of inflammatory cells in the mucosal area (**Figure 2D**). Group 5, namely treatment group 2, which was infected with *Salmonella typhimurium* bacteria and given telang flower infusa at a dose of 0.5 ml/20 gBW, had an average score of 1.25 ± 0.5, which was characterized by inflammatory cells in the mucosal area (**Figure 2E**). Group 6, namely treatment group 3, which was infected with *Salmonella typhimurium* bacteria and given telang flower infusa at a dose of 1 ml/20 gBW, had an average score of 2 ± 1.15, which was

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characterized by spreading inflammatory cells on all sides of the mucosa and submucosa (**Figure 2F**).

Based on statistical analysis using the Kruskal-Wallis test, it was shown that there was no significant difference (0.542>0.05) in the mean value of inflammatory cells in all groups. However, biologically, the administration of telang flower infusion can affect the average inflammatory cells in all groups (**Figure 3**).

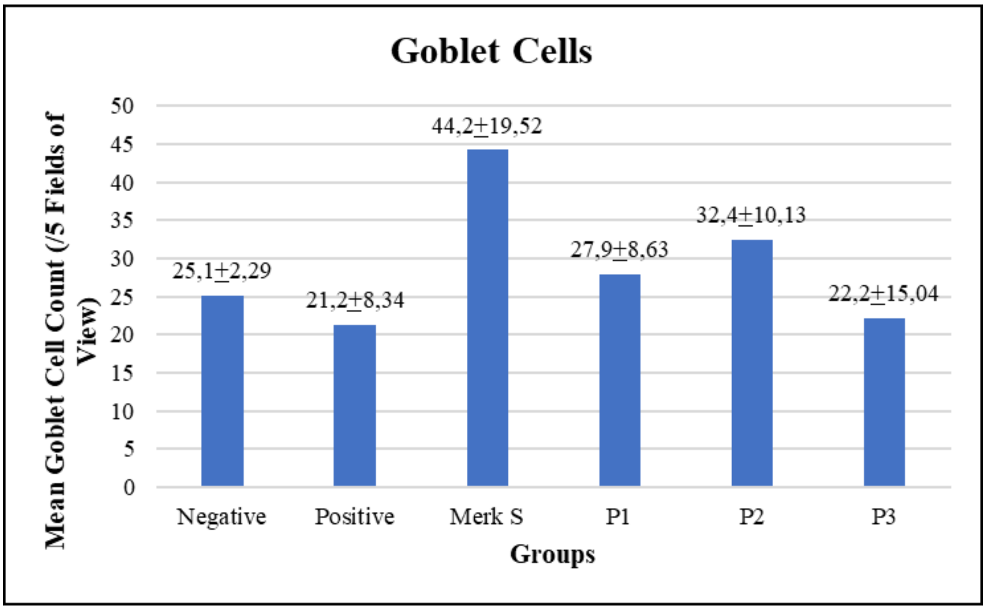
Previous research has shown that black grape extract can increase CD4+ T lymphocytes at low doses and decrease CD4+ T lymphocytes at high doses in the *Salmonella typhimurium* infection model mice (Destiawan *et al*., 2023), In addition, the effect of telang flower infusion can also increase the number of neutrophils and lymphocytes in mice infected with *Salmonella typhimurium* bacteria (Anggia Destiawan *et al*., 2024).

Based on the data above, it shows that the research conducted at this time is in line with previous research, namely the use of herbs with higher doses can increase immune cells in the *Salmonella typhimurium* bacterial infection model.

Goblet Cell Examination

The structure of the mucosa in colonic tissue consists of epithelium, lamina propria, and lamina muscularis. Damage to the gastrointestinal tract can occur if there is a disturbance in the balance between defense factors that maintain mucosal integrity and aggressive factors that damage mucosal defenses. One of the cell structures damaged by *Salmonella typhimurium* bacterial infection is the goblet cells (He *et al*., 2021).

Goblet cells are slender, elongated cells, mostly found in human organs that are responsible for mucus production. Goblet cells function to produce mucus to keep the outer layer of the cell from being damaged by the enzyme pepsin and stomach acid. Intestinal damage caused by Salmonella bacteria can reduce the mean number of goblet cells and mucus secreted by them (**Figure 4**).



The mean of Goblet Cells (/5 field of view) from each group is shown in **Figure 4**

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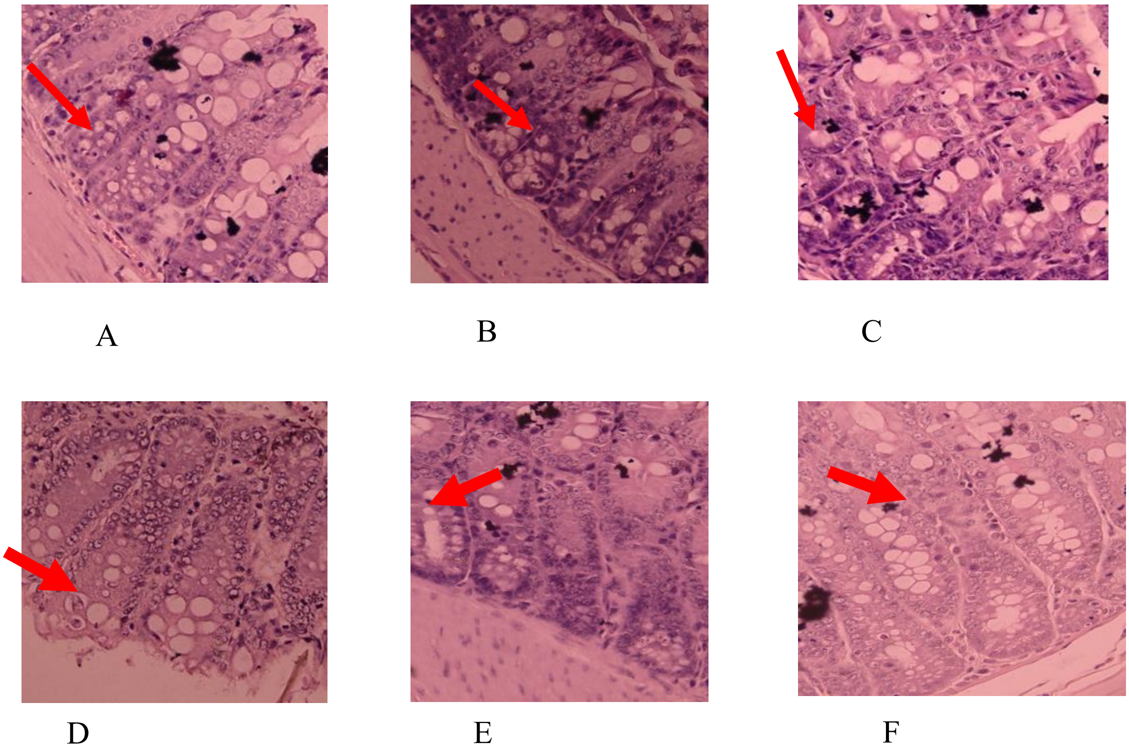

Examination of goblet cells in colon tissue is show in **Figure 5**. (A) negative control group, (B) positive control group, (C) Merk S group, (D) infusion of telang flower at a dose of 0.25 ml/20 gBW, (E) infusa of telang flower at a dose of 0.5 ml/20 gBW, (F)) infusion of telang flower at a dose of 1 ml/20 gBW. 400x magnification.

Based on Figure 3 shows that the average goblet cells in the negative control group (K-), which was not given treatment, amounted to 25.1 ± 2.29. The average goblet cells of the positive control group (K+) infected with *Salmonella typhimurium* bacteria and only given distilled water amounted to 21.2 ± 8.34. The average goblet cells of the Merk S group infected with *Salmonella typhimurium* bacteria were 44.2 ± 19.52. The average goblet cells of treatment group 1 (P1) infected with *Salmonella typhimurium* bacteria and given infusion of telang flowers at a dose of 0.25 ml/20 gBW amounted to 27.9 ± 8.63. The average goblet cells of treatment group 2 (P2) infected with *Salmonella typhimurium* bacteria and given telang flower infusa at a dose of 0.5 ml/20 gBW was 32.4 ± 10.13. The average goblet cells of treatment group 3 (P3), which was infected with *Salmonella typhimurium* bacteria and given telang flower infusa at a dose of 1 ml/20 gBW, was 22.2 ± 15.04.

Based on statistical analysis using the Kruskal-Wallis test, it was shown that there was no significant difference (0.269>0.05) in all groups. However, biologically, there was a difference in the average number of goblet cells in all groups (**Figure 4**).

Discussion:

Infection is a disease caused by microorganisms that enter and multiply in organs, in a broad group of microscopic organisms consisting of one or many cells, such as bacteria, fungi, parasites, and viruses. Infectious diseases can occur when there is interaction with microbes that can cause damage to the body and cause several symptoms and clinical signs. Bacterial infections can cause inflammation. A body infected with bacteria will cause immune cells to release pro-inflammatory cytokines. Especially Interleukin 1β (IL1β), Interleukin 6 (IL6), Interleukin 8 (IL8), and Tumour Necrosis Factor alpha (TNF-α). the cytokine can induce

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inflammatory cells, especially neutrophils. In acute infections, *Salmonella typhimurium* bacterial infection can increase the number of inflammatory cells that cause inflammation in the colon (**Figure 2B**) (Hidayah *et al.*, 2020). This increase is aimed at fighting the bacteria *Salmonella typhimurium*. The effect of an increase in inflammation causes an increase in ROS (Sahoo *et al*., 2023).

In the positive control group, a higher number of inflammatory cells was observed compared to the negative ctrol; however, statistical analysis using the Kruskal–Wallis test showed no significant difference (0.542>0.05). Mechanism *Salmonella typhimurium* diawali masuk kedalam brush border sel epitel intestinal, invasi ini dimediasi oleh type 3 secretion system (T3SS). T3SS adalah struktur molekuler yang berperan dalam menyuntikkan protein virulensi (SipA, SipC, SopE/SopE2, dan SopB) ke dalam sitosol, sehingga mempermudah bakteri masuk ke dalam sel yang menyebabkan kerusakan pada sel tersebut (Boyer, 2023). Damage occurs to the mucosal cells of the colon and goblet cells (**Figure 5B**), which is characterized by a decrease in the number of goblet cells in the intrstinal colon (**Figure 4 positive**). Damage of the colonic mucosa and goblet cells may elicit an inflammatory cells (**Figure 3 positive**) through the activation of the cyclooxygenase-2/prostaglandin E2 pathway, increased production of reactive oxygen species (ROS), and cytokine activation (He *et al*., 2021). However, statistically this increase was not significant between positive and negative controls (0.85>0.05). The elevation of ROS and pro-inflammatory cytokines, including IL-6, IL-8, IL-1β, and TNF-α, facilitates the infiltration and accumulation of inflammatory cells within the damaged colonic areas (**Figure 2B**).

The use of herbs of both Brand S and Folic Flower Infusion at doses of 0.25ml/20 gBW and 0.5ml/20 gBW can reduce the number of inflammatory cells (**Figure 3; Merk S, P1, and P2**), however, statistically the decrease in inflammatory cell infiltration in the Brands S, P1, and P2 groups was not significant with positive controls (0.57>0.05). The decrease in inflammatory cells is caused by *Phyllanthus niruri* from Merk S, and Infusa telang flower has the content of secondary compounds, flavonoids, steroids, saponins, tannins, and cyanogenic which function as natural immunomodulators. The flavonoid content will send intracellular signals to cell receptors to increase immunomodulatory activity (Perdana, 2022) While Telang flower infusion contains secondary compounds, anthocyanins, and flavonoids (Yurisna et al., 2022).

Flavonoids work by inhibiting Nuclear Factor kappa-B (NF-κβ). NF-κβ is a transcription factor that plays a role in regulating chemokines, cytokines, some cell adhesion, and regulates the formation of pro-inflammatory cytokines. Increased activation of NF-κβ, causing increased infiltration of inflammatory cells into damaged tissues, inhibition of NF-κβ activation by flavonoids causes inhibition of pro-inflammatory cytokines and cell adhesion, which plays a role in the process of infiltration into damaged tissues. In addition, the properties of flavonoids can also neutralize free radicals, namely Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS), as well as inhibit proinflammatory enzymes, namely COX, LOX, and NOS. Neutralized ROS and RNS can reduce goblet cell damage *(*Rakha *et al.,* 2022), resulting in an increase in the number of goblet cells (**Figure 4; Brands S, P1, and P2**) when compared with positive controls, but statistically this increase was not significant (0.15>0.05).

At a dose of 1 ml/20 gBW, there was an increase in inflammatory cells in colon tissue (**Figure 3; P3**). This increase leads to a decrease in goblet cells (**Figure 4; P3**), however, the increase in inflammatory cells and decrease in goblet cells were statistically insignificant when compared to the other groups. The increase in inflammatory cells and decrease in goblet cells at the dose of 1mlKurskal-wallisgBW is due to the high dose that causes a cytotoxic effect. Medicinal plants or herbs in high doses cause cytotoxic effects, namely genotoxic. Genotoxic is the damage of genetic material, namely DNA damage to cells (Qari *et al*., 2021), which can induce cell death (Zhao *et al*., 2023) which is characterized by a decrease in the number of cells, one of which is goblet cells (**Figure 4; P3**) and induce inflammation through DNA binding with Toll-Like Receptor 9 in the endosomal (De Gaetano *et al.*, 2021) thereby activating proinflammatory cytokines, activation of proinflammatory cytokines can increase the infiltration of inflammatory cells into damaged cells (**Figure 3; P3**).

Conclusions:

Based on the results of the study, a dose of 0.5ml/20 gBW is a dose that is able to reduce inflammatory cells and increase the number of goblet cells.

References:

Anggia Destiawan, R., Imroatul Muflihah, A., Hidayati, S., Hariani Nurjanah, M., Sandi Basuki, A. O., Asista Indarusanti, D., Hayati, F., & Amalia, N. (2024). EFFECT OF Clitoria ternatea Infusion On The Neutrophil Cells And Lymphocyte Cells In A Model Of Salmonella typhimurium INFECTION. *Jurnal Biosains Pascasarjana*, *26*(2), 185–192. https://doi.org/10.20473/jbp.v26i2.2024.185-192

Arifah, E. N. P. prabandari, sari. (2024). Uji Sifat Fisik Sediaan Face Toner Dari Ekstrak Infusa. *Jurnal Sains dan teknologi*, *7*(1), 101–109. http://journal.ummat.ac.id/index.php/justek

Boyer, J. L. (2023). Bile Acid Induced Inflammation and the Role of β-Catenin. *Cellular and Molecular Gastroenterology and Hepatology*, *16*(6), 1033. https://doi.org/https://doi.org/10.1016/j.jcmgh.2023.08.009

Budi, I. S., Kusumajaya, H., & Anggraini, R. B. (2024). Faktor-Faktor Yang Berhubungan Dengan Meningkatnya Penyakit Typhoid Fever Di Rumah Sakit Primaya Bhakti Wara Tahun 2024. *Jurnal Penelitian Keperawatan*, *10*(2), 328–341. https://doi.org/10.32660/jpk.v10i2.788

De Gaetano, A., Solodka, K., Zanini, G., Selleri, V., Mattioli, A. V, Nasi, M., & Pinti, M. (2021). Molecular Mechanisms of mtDNA-Mediated Inflammation. In *Cells* (Vol. 10, Issue 11). https://doi.org/10.3390/cells10112898

Destiawan, R. anggia, Rahmawati, S. eka, Wijaya, A. fadli, Muflihah, A. I., Nurjanah, M. H., Hidayati, S., & Sari, N. K. Y. (2023). Effect Of Black Grape Extract On Cd4+ And Cd8+ Expression In Mice Infected With Salmonella typhimurium. *Jurnal Biosains Pascasarjana*, *24*(1SP), 54–63. https://doi.org/10.20473/jbp.v24i1sp.2022.54-63

Hayati, S. J., & Ikhsani, A. (2021). Vaksinasi Sebagai Pencegahan Resistensi Antimikroba Terhadap Bakteri Salmonella Typhi. *Jurnal Kesehatan Tambusai*, *2*(3), 276–283. https://doi.org/10.31004/jkt.v2i3.2376

He, Y., Ayansola, H., Hou, Q., Liao, C., Lei, J., Lai, Y., Jiang, Q., Masatoshi, H., & Zhang, B. (2021). Genistein Inhibits Colonic Goblet Cell Loss and Colorectal Inflammation Induced by Salmonella Typhimurium Infection. *Molecular Nutrition and Food Research*, *65*(16). https://doi.org/10.1002/mnfr.202100209

Hidayah, N., Puspita, R., & Mujahidah. (2020). Effect of Curcuma domestica Val Extract on Body Weight, Total of Eosinofils and Basofils in Laying Hens Infected with Salmonella pullorum. *Jurnal Medik Veteriner*, *3*(2), 230–235. https://doi.org/10.20473/jmv.vol3.iss2.2020.230-235

Khairunnisa, S., Hidayat, E. M., & Herardi, R. (2020). Hubungan Jumlah Leukosit dan Persentase Limfosit terhadap Tingkat Demam pada Pasien Anak dengan Demam Tifoid di RSUD Budhi Asih Tahun 2018 – Oktober 2019. *Seminar Nasional Riset Kedokteran (SENSORIK)*, 60–69. https://conference.upnvj.ac.id/index.php/sensorik/article/download/434/196

Marsa, A., Elmiyati, & Ananda, E. (2020). Hubungan Personal Hygiene dan Sanitasi Lingkungan Terhadap Prevalensi Terjadinya Demam Tifoid di Rumah Sakit Umum Daerah (RSUD) Meuraxa Kota Banda Aceh Tahun 2018. *Riset Dan Inovasi Pendidikan*, *2*(2), 24–34.

Mustofa, F. L., Rafie, R., & Salsabilla, G. (2020).

Karakteristik Pasien Demam Tifoid pada Anak dan Remaja. *Jurnal Ilmiah Kesehatan Sandi Husada*, *12*(2), 625–633. https://doi.org/10.35816/jiskh.v12i2.372

Patel, A. A., Ginhoux, F., & Yona, S. (2021). Monocytes, macrophages, dendritic cells and neutrophils: an update on lifespan kinetics in health and disease. *Immunology*, *163*(3), 250–261. https://doi.org/10.1111/imm.13320

Perdana, P. R. (2022). Review: Aktivitas Imunomodulator Ekstrak Herba Meniran (Phyllanthus niruri L.). *Jurnal Farmagazine*, *9*(1), 50. https://doi.org/10.47653/farm.v9i1.545

Piovani, D., Figlioli, G., Nikolopoulos, G. K., & Bonovas, S. (2024). The global burden of enteric fever, 2017–2021: a systematic analysis from the global burden of disease study 2021. *EClinicalMedicine*, *77*. https://doi.org/10.1016/j.eclinm.2024.102883

Prasetia, D. I., Inggriani, M., & Ilsan, N. A. (2019). Uji Sensitivitas Antibiotik Kotrimoksazol Terhadap Bakteri Salmonella Sp. Dengan Metode Modifikasi Kirby-Bauer. *Jurnal Mitra Kesehatan*, *2*(1), 7–11. https://doi.org/10.47522/jmk.v2i1.23

Qari, S. H., Alrefaei, A. F., Ashoor, A. B., & Soliman, M. H. (2021). Genotoxicity and Carcinogenicity of Medicinal Herbs and Their Nanoparticles. In *Nutraceuticals* (Vol. 1, Issue 1, pp. 31–41). https://doi.org/10.3390/nutraceuticals1010005

Rakha, A., Umar, N., Rabail, R., Butt, M. S., Kieliszek, M., Hassoun, A., & Aadil, R. M. (2022). Anti-inflammatory and anti-allergic potential of dietary flavonoids: A review. *Biomedicine & Pharmacotherapy*, *156*, 113945. https://doi.org/https://doi.org/10.1016/j.biopha.2022.113945

Rizki Febrianti, D., Niah, R., & Ariani, N. (2020). Antibakteri Kumpai Mahung (Einulifolium H.B&K) Terhadap Salmonella Typhi. *Jurnal Insan Farmasi Indonesia*, *3*(2), 253–260. https://doi.org/10.36387/jifi.v3i2.632

Sahoo, D. K., Heilmann, R. M., Paital, B., Patel, A., Yadav, V. K., Wong, D., & Jergens, A. E. (2023). Oxidative stress, hormones, and effects of natural antioxidants on intestinal inflammation in inflammatory bowel disease. *Frontiers in Endocrinology*, *14*(August), 1–24. https://doi.org/10.3389/fendo.2023.1217165

Yurisna, V. C., Nabila, F. S., Radhityaningtyas, D., Listyaningrum, F., & Aini, N. (2022). Potensi Bunga Telang (Clitoria ternatea L.) sebagai Antibakteri pada Produk Pangan. *JITIPARI (Jurnal Ilmiah Teknologi Dan Industri Pangan UNISRI)*, *7*(1), 68–77. https://doi.org/10.33061/jitipari.v7i1.5738

Zahara, S. L., Lubis, M. S., Dalimunthe, G. I., & Nasution, H. M. (2022). Aktivitas Antibakteri Ekstrak Etanol Lidah buaya (Aloe Vera L.) Terhadap bakteri Propionibacterium acnes. *Journal of Health and Medical Science*, *1*(2), 157–168.

Zhao, Y., Simon, M., Seluanov, A., & Gorbunova, V. (2023). DNA damage and repair in age-related inflammation. *Nature Reviews Immunology*, *23*(2), 75–89. https://doi.org/10.1038/s41577-022-00751-y

Zizza, A., Fallucca, A., Guido, M., Restivo, V., Roveta, M., & Trucchi, C. (2025). Foodborne Infections and Salmonella: Current Primary Prevention Tools and Future Perspectives. In *Vaccines* (Vol. 13, Issue 1). https://doi.org/10.3390/vaccines13010029