INTRODUCTION
The butterfly pea plant, scientifically known as *Clitoria ternatea*, is widely distributed in Indonesia and is commonly utilized by the local population. It bears distinctive blue-colored, zygomorphic flowers resembling a pea containing anthocyanin and other secondary metabolites like ternatin. Butterfly peas are often used in various fields, including agriculture, food coloring, cosmetics, medicine, and insecticides. Moreover, the plant has gained attention for its antioxidant properties. In traditional medicine, butterfly pea has been extensively used to improve cognitive function and alleviate symptoms such as fever, inflammation, pain, and diabetes.

Indonesia is a country rich in medicinal plants that have the potential to be developed for treatment. Various studies have been conducted to determine the health effects of traditional plants, including research on the effects of the butterfly pea plant (*Clitoria ternatea*). This review of the literature aims to explore the characteristics and various health benefits associated with the butterfly pea.

METHOD
The search process involved using electronic databases on Google Scholar, PubMed, and ScienceDirect with pages related to the keywords “butterfly pea health benefit”, “Clitoria ternatea”, and “flavonoid in Clitoria ternatea”. Primary data is obtained with sources of research results that have been published in national and international journals.

RESULT
Characteristic of Butterfly Pea (*Clitoria ternatea*)
The butterfly pea, belonging to the *Fabaceae* family, is widely distributed globally, particularly in tropical and subtropical regions. This plant originates from central South America and spreads to tropical regions in the 19th century, including Indonesia. The *Fabaceae* family is widely used as a food source and encompasses many medicinal plant species in Indonesia, totaling 110 species. The butterfly pea plant is characterized by its distinct blue flowers and belongs to the Clitoria genus, which comprises 60 species known for their adaptability to various environmental conditions. These flowers can thrive in regions with high and low rainfall, displaying disease tolerance due to their nitrogen-modifying capabilities.

The ideal conditions for growing butterfly pea include a temperature range of 24-32°C, moist soil with a depth of 2.5-5 cm, and a spacing of 20-30 cm.

Additionally, the butterfly pea plant features slender stems and grows as a perennial twining vine, requiring support. It also has a pod-shaped fruit and small leaves arranged in pairs.

Due to its resemblance to a butterfly, it is commonly called the butterfly or blue pea. In Indonesia, it is also known by various local names such as *kelentit* flowers, *kembang teleng* or *menteleng* flowers on Java Island, *celeng* in Bali, *bunga talang* or *taman lereng* in Sulawesi, and *bisi* flowers or *syamagulele* in Maluku.

Butterfly pea is a plant rich in nutrients and is used as animal fodder in several countries. It is also used as a traditional medicine in India. Numerous studies have investigated the phytochemical composition of the butterfly pea. It contains a variety of compounds such as tannins, flavabatins, carbohydrates, saponins, triterpenoids, terpenoids, phenols, flavonoids, flavonol glycosides,
proteins, alkaloids, anthraquinones, anthocyanins, volatile oils, sterols, and steroids. The composition of fatty acids includes palmitic, stearic, oleic, linoleic, and linolenic acids.\textsuperscript{4,5} Phytochemical tests have identified flavonoid glycosides like rutin, kaempferol, delphinidin, quercetin, and malvidin, which contain delta-lactone from 2-methyl-4-hydroxy-n-pentacosanoic acid. There was no mortality up to a dose of 2 grams per kilogram when administered orally to experimental rats.\textsuperscript{4}

The roots, leaves, and flowers are commonly extracted and used for topical and oral treatments due to their high flavonoid content. A study by Verma et al. revealed that the ethanol extract of \textit{Clitoria ternatea} contained 13.53\% flavonoids and 4.62\% flavanones.\textsuperscript{4} Cream extract from \textit{Clitoria ternatea} flowers at a concentration of 5\% exhibited significant levels of flavonoids (7421.33 mg/100 gram), phenols (1883.23 mg/100-gram GAE), tannic acid (2445.07 mg/100-gram TAE), antioxidant capacity (8719.71 mg/L GAEAC), and IC50 value of 73.7915 ppm.\textsuperscript{6} Similarly, a study in Yogyakarta aimed to determine the optimal concentration of \textit{Clitoria ternatea} extract in ethanol for reducing carrageenan-induced skin edema in mice. The study demonstrated that 1\% and 1.5\% \textit{Clitoria ternatea} extract inhibited inflammation by 50.75\% and 67.28\%, respectively.\textsuperscript{7}

**Health Benefits of Butterfly Pea**

**Food and Medicine**

For a long time, butterfly pea (\textit{Clitoria ternatea}) has been utilized as a traditional remedy to treat various ailments. The flowers and leaves of the plant are commonly used for medicinal purposes.\textsuperscript{3} In traditional medicine, flowers are employed in treating respiratory disorders like bronchitis,\textsuperscript{8} and they are also utilized in the food industry as a natural food coloring agent for items such as syrup, cakes, ice lollies, muffins, and yogurt.\textsuperscript{4}

The flowers of butterfly peas contain active compounds with potential medicinal applications in treating various diseases, including rheumatoid arthritis, ear disorders, skin disorders, tumors, cataracts, asthma, and infectious diseases.\textsuperscript{9,15} On the other hand, butterfly pea leaves are known for their efficacy in treating purulent wounds and vaginal discharge.\textsuperscript{3} Research has explored various pharmacological effects of butterfly peas, including antibacterial, anti-parasitic, anti-inflammatory, immunosuppressant, analgesic, antipyretic, antitumor, antiinflammatory, antidiabetic, and anthistamine properties.\textsuperscript{2,4,5} The presence of polyphenolic compounds such as saponins, tannins, steroids, triterpenoids, kaempferol, and quercetin in butterfly pea flowers can contribute to its antitumor activity by suppressing cell proliferation.\textsuperscript{16}

A similar study has highlighted that the taraxerol found in butterfly pea flowers exhibits cytotoxic activity and triggers apoptosis in cancer cells through cell cycle arrest in pre-G1 and S phases.\textsuperscript{13} **Anti-inflammatory, analgesic, and antipyretic effects**

Indrayani conducted a study investigating the anti-inflammatory effects of topically applied \textit{Clitoria ternatea} L. extract on carrageenan-induced skin edema in female Swiss strain mice. The results revealed that the ethanol extract of \textit{Clitoria ternatea} L. exhibited a topical anti-inflammatory effect comparable to Voltaren gel. The percentages of inflammatory inhibition for 1\% and 1.5\% concentrations of \textit{Clitoria ternatea} L. extract were 50.75\% and 67.28\%, respectively.\textsuperscript{7} This finding aligns with other studies that have reported the significant inhibitory effects of ethanol extract from butterfly pea flowers and methanol extract from butterfly pea roots on carrageenan-induced edema and vascular permeability in rats.\textsuperscript{8,17} Another study by Devi et al. 2003 demonstrated that oral administration of methanol extract of butterfly pea root at doses of 200 and 400 mg/kg effectively reduced edema caused by inflammation and exhibited antipyretic properties. Furthermore, 400 mg of butterfly pea flower extract orally showed a similar antipyretic effect to diclofenac sodium at 20 mg/kg.\textsuperscript{17} A similar study conducted in 2004 highlighted the antipyretic effect of orally administered butterfly pea extract at 200-400 mg/kg doses, which exhibited similarities to the effect of paracetamol at 150 mg/kg.\textsuperscript{18} **Immunosuppressive and antioxidants**

A study conducted by Ma’ruf in 2022 revealed the immunomodulatory potential of butterfly pea flower extract, attributed to its compounds that can both stimulate and suppress pro-inflammatory cytokines.\textsuperscript{9} The presence of flavonol glycosides in butterfly pea flowers contributes to its immunosuppressive and antioxidant effects by inhibiting the activity of iNOS, COX, and LOX enzymes and reducing NF-kB-DNA binding to suppress inflammation. Furthermore, the natural active compounds in butterfly pea flowers, including anthocyanins and tannins, play a role in preventing inflammation by reducing the levels of TNF-\alpha, MPO, and IL-6 cytokines, increasing IL-10 levels, and enhancing the binding affinity of human beta defensin-2 (HBD2), thereby boosting the innate immune response in the mucosa.\textsuperscript{11} Anthocyanin pigments, belonging to the flavonoid class, serve as bioactive substances due to their antioxidant properties, while tannins and anthocyanins, as secondary metabolites, act as free radical scavengers with their double conjugated bonds.\textsuperscript{2,19} Similar studies have also demonstrated a statistically significant decrease in average IL-6 levels in leprosy patients who were administered butterfly pea extracts. Flavonoids, as phenolic compounds, possess antioxidant capabilities by binding metals and donating hydrogen atoms, thus preventing cell damage caused by free radicals. These compounds can suppress the MAPK pathway, including ERK, JNK, and p38, which, in turn, inhibits the NF-kB pathway and triggers the activation of anti-inflammatory cytokines such as TGF-\beta, inhibiting MMP-1 transcription while stimulating procollagen I and III. On the other hand, Phenol acts as a free radical scavenger, offering protection against cellular oxidative stress. Moreover, butterfly pea flower extract has been found to inhibit the cyclooxygenase enzyme, thereby impeding arachidonic acid metabolism, prostaglandin production, and inflammatory processes.\textsuperscript{19,21} **Antihyperglycemic**

According to a study by Chusak et al. 2018, the butterfly pea flower has demonstrated antioxidant and antihyperglycemic effects. Administering one to two grams of butterfly pea extract in 400 mL of water orally to adults can increase plasma
Antioxidant levels. Additionally, butterfly pea flowers can reduce postprandial blood sugar and insulin levels while improving postprandial antioxidant status. These effects are attributed to the bioactive compounds in butterfly pea flowers, namely polyphenols and anthocyanins, which inhibit the enzyme alpha-amylase in the pancreas and alpha-glucosidase activity. Similarly, a study by Kavitha et al. in 2018 revealed that a combination of Clitoria ternatea and Trichosanthe dioica leaf extracts can reduce blood sugar levels, HbA1c, and increase serum insulin levels in rats with diabetes.

Furthermore, a study conducted by Verma et al. in 2013 indicated that butterfly pea flowers' flavonoid content can aid in pancreas regeneration, as observed through increased islet neogenesis in experimental rats. In diabetes, elevated blood sugar levels can increase free radicals, reducing antioxidant capabilities by damaging enzymes and antioxidant substances. The potency of butterfly pea extract correlates with higher levels of polyphenols and flavonoids, indicating increased polymerization and segregation of secondary metabolites such as sterols, terpenoids, and complex polyphenols. These findings support the potential of butterfly pea extract as an antidiabetic agent.

**Antihyperlipidemic**
The study conducted by Solanki et al. in 2010 demonstrated that extracts obtained from the seeds and roots of the butterfly pea plant can lower the overall cholesterol and triglyceride levels in experimental animals. The butterfly pea extract achieves this by reducing cholesterol absorption and increasing its excretion through the feces via enhanced biliary excretion. This is particularly beneficial for individuals suffering from hypertriglyceridemia and hypercholesterolemia, which are metabolic disorders caused by insulin deficiency leading to impaired activation of the lipoprotein lipase enzyme. This impaired activation results in elevated levels of triglycerides. Moreover, the abnormal metabolism of fatty acids caused by glucose toxicity generates hydrogen peroxide and ketoaldehyde, leading to chronic oxidative damage. However, the use of butterfly pea flower extract has shown promise in regulating blood sugar levels, indicating its potential to decrease lipid levels in the bloodstream.

**Anti-allergy and antitussive**
According to a study conducted by Singh et al. in 2018, it was found that butterfly pea flower extract possesses properties that can alleviate allergies and suppress coughing in experimental animals. The extract achieves this by diminishing the immune response facilitated by IL-1β and IL-6, which are responsible for transforming respiratory tract epithelial cells into goblet cells that produce excessive mucus. Consequently, the production of mucus is reduced. Additionally, the butterfly pea flower extract acts as an antitussive agent by exerting antihistaminergic and antiallergic effects. The administration of butterfly pea flower extract resulted in decreased levels of white blood cells, interleukins, and immunoglobulins in experimental animals. It also reduced the incidence of shortness of breath triggered by histamine.

**Anti-aging**
A recent study has shown that applying a cream containing butterfly pea flower extract with a concentration of 5% topically can exhibit anti-aging effects. Specifically, this extract effectively inhibits the levels of MMP-1, an enzyme that contributes to collagen degradation. The presence of flavonoid and phenolic compounds in the extract acts as metal chelators and stabilizes hydrogen atoms within the hydroxyl groups. This stabilization mechanism plays a significant role in preventing the formation of reactive oxygen species (ROS) and counteracting photoaging effects. Furthermore, butterfly pea flower extract shows the potential to protect the skin from the harmful effects of UVB radiation. It achieves this by regulating the TGF-beta gene, which helps restore lost collagen caused by UVB exposure. Additionally, the extract acts as an antioxidant, effectively suppressing photo-oxidation processes.

**Antimicrobial**
Multiple studies have demonstrated the anthelmintic and antimicrobial properties of Clitoria ternatea extract. A study conducted by Alnaz et al. in Indonesia revealed that different dilutions (1:4, 1:40, and 1:400) of Clitoria ternatea extract were as effective as levamisole at concentrations of 1 mg/mL and 0.1 mg/mL in inducing paralysis and death in helminths. A similar study has also shown that extracts of butterfly pea roots in methanol potentially cause the death of worms in a shorter time. Moreover, the protein finotin in butterfly pea plants demonstrated inhibitory effects on fungal pathogens in humans and Gram-negative bacteria in laboratory settings. Additionally, methanol extracts from butterfly pea leaves exhibited antibacterial properties against Streptococcus agalactiae, Salmonella typhi, and Staphylococcus aureus, with inhibition rates comparable to ampicillin ones.

**Antidepressants**
Butterfly peas are also known to have antidepressant effects. Previous research showed that a compound in butterfly pea leaf extract—clitorin (kaempferol glucopyranoside) — can penetrate the blood-brain barrier. Another study by Ravishankar in 2013 showed that butterfly pea root extract given orally showed a decrease in motor and locomotor coordination activity. The 150 mg/kg and 300 mg/kg doses showed significant antidepressant effects compared to sedative doses of imipramine (300 mg/kg) in experimental animals.

**CONCLUSION**
Butterfly pea (Clitoria ternatea) has been known for its benefits in medicine and health as it contains chemical compounds called flavonoids, which are antioxidants. Some of the pharmacological effects of butterfly pea flowers studied in experimental animals include antimicrobial, immunosuppressive, antioxidant, antidiabetic, antihyperlipidemic, anti-allergic, antitussive, anti-aging, and antidepressant. Further research needs to be conducted to analyze the benefits of butterfly peas in humans.

**CONFLICT OF INTEREST**
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REFERENCES