

# The Potency of Tryptophan Compound in a Combination of Bali Green Banana (*Musa acuminata* Colla) and Java Pineapple (*Ananas comosus* L. Merr) Extract and Its Opportunities as a Suppressive Self-behavior from Natural Ingredient

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**Abstract.** The Bali green banana is commonly given as additional food for babies and the elderly, because of its high nutritional value and safe for digestion. While Java pineapple which is familiar as “nanas madu” has a sweet taste and is rich in an active compound associated with mood. A previous study found that adult people with and without intermittent explosive disorder with lowered serotonin bioavailability tend to self-aggressive behavior. Tryptophan depletion causing low serotonin precursor is associated with aggressive behavior. Adequate intake of tryptophan sourced from fruits is needed for physiological mechanisms, especially in the serotonergic system. The efficacy of antioxidant content in Java pineapples (*Ananas comosus* L. Merr) combined with tryptophan compound in Bali green banana (*Musa acuminata* Colla) has the potential to suppress an aggressive behavior through the serotonergic system homeostasis mechanism. This study aimed to find the tryptophan compound in an extract of Bali green banana which is a combination with Java pineapple. Methods: tryptophan compounds in this simplicia extract were analyzed by the High-performance liquid chromatography (HPLC) method. Result: the extract of Bali green banana Bali combined with Java pineapple showed the tryptophan content was 0.316 mg/100gr simplicia. Conclusion: an extract of Bali green banana combined with Java pineapple contains 0.316 percent tryptophan. This combination of compounds has the potential as a new combination of natural sources of suppressive self-aggressive behavior.

## 1 Introduction

Chronic stress is caused by various factors, including the current prolonged Covid-19 pandemic, as well as nutritional factors. Those factors can affect the homeostasis of the body's serotonergic system which has an impact on physical and mental health. One of the manifestations of the disruption of the homeostasis system is the emergence of self-aggressive behavior. Aggression behavior is defined as an affectively driven attack on another with the intent to harm. While self-aggression is behavior that results in harm to oneself. Aggression may appear as hostile, threatening, and violent behaviors [1]. According to American Psychiatric Association (2013), agitation, anger, hostility, impulsivity, and irritability as the most important terms that are related to and encompass aggression and related behaviors[2].

In general, for medical treatment, aggressive behavior in cases of mental illness is handled with several medication options including mood stabilizers, antiepileptic drugs, or omega-3 supplements [3,4]. In this study, an exploration finding of tryptophan compounds

sourced from fruits for the future can be used as alternative supplements that have a work target as a mood lifter and are safer comparing the chemical product.

Theoretically, the amino acid tryptophan which is a serotonin precursor has a role in the mood so it also plays a role in calming an aggressive behavior. Adequate intake of tryptophan sourced from fruits is needed by the body to support the physiological mechanisms of the serotonergic system and melatonin, and it's associated with its effect on suppressing self-aggressive behavior. Based on physiologic mechanism, serotonin is released in the neuronal synaptic cleft through two major mechanisms, such as reuptake into presynaptic neurons and metabolism by monoamine oxidase-A into 5-hydroxyindoleacetic acid. Pharmaceutical products with potency in inhibiting serotonin reuptake or inhibiting the activity of the monoamine oxidase enzyme can increase the concentration of serotonin in the synaptic cleft. So, we know that tryptophan intake is required for adequate serotonin precursors.

Sources of tryptophan from fruits that are abundant in Indonesia as a tropical country are needed to be explored

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for an alternative supplementation product. Two types of tropical fruit that were explored to find the tryptophan content in this study were banana and pineapple. For people in Indonesia, the ambon banana, including the Bali green banana, has long been consumed as additional food for babies and the elderly, because of its good nutritional content and safe for digestion. While pineapples are high in water content and rich in fiber have been shown to contain active compounds that are associated with their effects on mood. So, it is important to conduct an exploratory study to find the tryptophan content in these two types of fruits. This can also enrich the public's understanding of the importance of consuming a diet containing adequate tryptophan, especially during the current prolonged Covid-19 pandemic.

Previous research has shown that tryptophan depletion is one of the factors associated with aggressive behavior [5]. Although nutritional factors are certainly not the only factors behind this aggressive behavior. Aggression is a complex behavior that is modulated by neurotransmitter systems at the level of the synthesis and the metabolism of various neurotransmitters and their receptors. The main receptor involved in the neurobiology of aggression is serotonin as a monoamine neurotransmitter [6].

This study aimed to find the tryptophan compound in an extract of the combination of Bali green banana and Java pineapple.

## 2 Material and Method

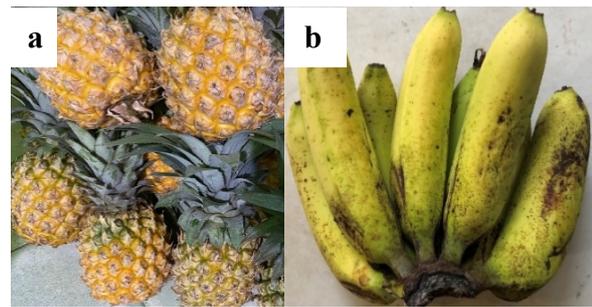
This study was conducted in July 2021. Fruit drying process using Mundalech brand food dehydrator. Bananas are obtained from agriculture in Klungkung Village Bali and pineapples from agriculture in Belik, Pemalang Regency, Central Java. Identify Bali green banana and Java pineapple conducted at UPTD Bali Seed Center for Food Crops and Horticulture.

The banana and pineapple after the drying process was grinded to form simplicia powder and sent in 6 packages of 100g each to Saraswati Indo-Genetec (SIG) Laboratory Bogor. An analysis of compounds of an extract of the combination of Bali green banana and Java pineapple were analyzed at SIG Laboratory, using the High-performance liquid chromatography (HPLC) method. Filtrates made from the extraction process were injected into the HPLC and analyzed by a standard compound comparison simultaneously.

## 3 Result and Discussion

We found that an extract of Bali green banana which was in a combination with Java pineapple showed the tryptophan content was 315.79 mg/Kg of simplicia (or 0.316 mg/100gr). The simplicial is brown color with a dominant aroma of pineapple. Figures 1 & 2 below are the bananas, pineapples, and the simplicia.

The finding of the amino acid tryptophan which is a serotonin precursor in this study assumes the potency of the extract in its effect on suppressing aggressive behavior, as we know that this behavior mechanism involves the serotonergic system as one of the factors that influence it.



**Figure 1.a).** Java pineapple is physiologically ripe, 4th day after harvest; **1b)** Bali green banana is physiologically ripe, 6th day after harvest. (The private picture's source)



**Figure 2.** Bali green banana in combination with Java pineapple simplicia. (The private picture's source)

This is the first report of tryptophan content in an extract of a combination of local fruits in Bali. The daily requirement of tryptophan range from 3.5 to 6 mg/kg BW per day. Based on our results, 100gr of simplicia extract contains 0.316 mg tryptophan. If it is given two times a day for people with a body weight of 70 kg, it gives an additional 0.3% RDA (Recommended Dietary Allowances). This finding could be assumed the potency of Indonesian local fruits as a supplement to support a conventional therapy for mental health cases with symptoms of self-aggressive behavior triggered by low intake of tryptophan. This condition could be exacerbated by chronic stress conditions, especially during the current prolonged Covid-19 pandemic. In a Clinical trial, a study by McCloskey et al (2009) found that aggressive behavior was shown by their study participants who received a diet with low tryptophan content [5]. Another study found that chronic stress causes inhibiting the activity of mature granule cells in the ventral dentate gyrus (vDG), a subregion implicated in mood regulation [7]. This mechanism supports the potential effect of tryptophan as a serotonin precursor in an extract of Bali green banana combined with Java pineapple (with a certain dose) has an effect on mood as a role to suppress aggressive behavior. The tryptophan compound which will be used in a phytopharmaceutical preparation will show an effect in suppressing aggressive behavior if it is significantly effective for both the availability of serotonin in the synaptic cleft and its effect on serotonin transporter receptors [8]. So, the tryptophan intake sources from an extract of Bali green banana which was in a combination

with Java pineapple can have the potency to suppress aggressive behavior if it could be seen its effect in restoring serotonin homeostasis.

According to Krakowski [9], the main metabolite of 5-HT, 5-hydroxyindoleacetic acid, is reduced in the cerebrospinal fluid of people with demonstrated auto- or hetero aggressive behavior compared with people who have never shown such behavior. These observations were made in suicidal individuals, in non-depressed men with a history of aggressive behavior.

Currently, studies related to the potential of tryptophan supplementation on aggressive behavior are still not consistent yet. Also, the association between serotonin levels, amygdala regulation, and aggression is still a matter of debate [10]. A previous study investigated the influence of brain serotonin modulation on functional amygdala connectivity during aggressive behavior. The study found an acute tryptophan depletion (ATD) impact on aggression-specific amygdala connectivity in bilateral supramarginal gyrus (SMG). Moreover, serotonergic modulation ability varied as a function of trait aggression in prefrontal cortex (PFC) regions, with higher aggression predicting a stronger ATD impact during virtual violence. They conclude that the serotonergic corticolimbic projections contribute to aggressive behavior [10]. According to this study, ATD challenge has been reported to reduce the processing of aggression-relevant stimuli in the amygdala-PFC system [11]. Based on those inconsistent findings on the effect of tryptophan related to aggression behavior, further studies are still needed. An animal study by Kolik et al [12], found no evidence of behavioral changes in experimental animals becoming aggressive after discontinuation of tryptophan-containing dipeptide administration 24h and 48 hours after the onset of the experiment.

Finally, we understand that there are several weaknesses in this study, such as this study is preliminary and has not explored the content of other active compounds that may have good potential against serotonin receptor targets. In silico studies of other compounds, such as catechins, and also phenidine, have shown a good match between binding with serotonin transporter, as well as antioxidant content in the simplicial extract. So this exploratory study requires further studies starting from animal studies followed by clinical trials to determine the consistency of the effect of an extract of Bali green banana combined with Java pineapple on the serotonergic system and its potential to suppress aggression behavior. The clinical impact of this study is giving a chance for finding safe products for supplementation therapy that are beneficial for physical and mental health.

## 4 Conclusion

It could be the conclusion that an extract of Bali green banana combined with Java pineapple contains tryptophan 0.316 mg/100gr of simplicia. The finding of the amino acid tryptophan which is a serotonin precursor indicates the potential of this combination of fruit extract as a natural source to suppress aggressive behavior.

## Authors' Contributions

SP and CBJL participated in writing the manuscript. LPW was involved in technical laboratory work and consulting.

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