Characteristics of M*yrmecodiapendans* Instant Powder Produced by Foam Mat Drying

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Abstract. *Myrmecodiapendans* is a plant species known for its rich bioactive compounds, traditionally used as herbal remedies for various diseases. Recently, *Myrmecodiapendans* instant powder was developed using the foam mat drying method, where egg white was used as a foaming agent and maltodextrin as a stabilizer. The purpose of this research was to determine the effects of egg white and maltodextrin concentration on the characteristics of *Myrmecodiapendans* instant powder. The study used a completely randomized design with two factors, namely egg white and maltodextrin concentration, each with three concentration levels: 5%, 10%, and 15%. The results revealed that egg white and maltodextrin concentrations significantly influenced all characteristics of the instant powder except overall preference. Increasing the concentration of egg white and maltodextrin produced *Myrmecodiapendans* instant powder that was brighter, had higher total soluble solids, dissolved more quickly, and had lower moisture content and total polyphenols. The antioxidant activity of *Myrmecodiapendans* instant powder increased with an increase in egg white concentration, while it decreased with an increase in maltodextrin concentration. The best results were obtained when preparing *Myrmecodi pendans* instant powder using 15% egg white and 10% maltodextrin concentration.

Keywords: Myrmecodiapendans instant powder, foam mat drying, bioactive compounds

INTRODUCTION

Myrmecodiapendans is an epiphytic plant belonging to the *Hydnophytinae (Rubiceae)* family. It has been traditionally used to treat various diseases and is rich in bioactive compounds. *Myrmecodiapendans* contains flavonoids such as apigenin, rutin, kaempferol, luteolin, and quercetin [1], as well as three major phenolic compounds: rosmarinic acid, procyanidin B1, and polymer of procyanidin B1 [2]. It can be used as an herbal remedy without any toxic effects on cells [3]. To make it more practical for consumers, *Myrmecodiapendans* can be processed into instant powder using the foam mat drying method.

Foam mat drying (FMD) is a drying process that has several advantages over other methods. It retains bioactive compounds, dries products quickly at lower temperatures, and produces powders at a lower cost [4]. Many studies have used FMD to produce powders containing bioactive compounds, such as papaya [5], jambolana *Syzygium cumini* (L.) [6], peaches [7], kecombrang flower (*Etlingera elatior)* [8], green coffee extracts [9], tomatoes [10], mangoes [11], inulin of white sweet potato [12], and Indonesian black glutinous rice anthocyanins [13]. To create a stable foam, FMD requires a foaming agent like egg white.

Egg white contains various proteins, including ovalbumin, conalbumin, ovoglobulin, ovomucin, and lysozyme. When whipped, the proteins denature at the interface and interact with each other to create a stable foam. This foam increases surface area and reduces drying time, even at low temperatures. For a stable foam, egg white concentration should be 15% and whipped for 15 minutes. Adding a stabilizer, such as maltodextrin, can further increase foam stability by slowing down mechanisms like drainage, coalescence, and coarsening [14]. This study aims to investigate the effect of egg white and maltodextrin concentrations on the characteristics of *Myrmecodiapendans* instant powder.

I. H. Agustin (ed.), *Proceedings of the 2nd International Conference on Neural Networks and Machine Learning 2023 (ICNNML 2023)*, Advances in Intelligent Systems Research 183,
https://doi.org/10.2991/978-94-6463-445-7_26

Material and Methods

Material and Methods

The research materials consist of dried hypocotyls from *Myrmecodiapendans* (purchased online), egg white from whole egg (purchased locally), distilled water, maltodextrin DE 18, ethanol, methanol, gallic acid, Folin-Ciocalteu reagent, sodium carbonate, and DPPH.

Experimental design

The experiment was conducted using a Randomized Complete Design, with two factors namely egg white and maltodextrin concentration. Each factor had three concentration levels: 10%, 15%, and 20%, and each treatment was repeated three times.

Preparation of *Myrmecodiapendans* extract

The dried hypocotyl of *Myrmecodiapendans* was ground and then sifted using a 60-mesh sieve. The *Myrmecodiapendans* powder obtained was extracted with 70% ethanol at a ratio of 1:10 (weight to volume). The mixture was stirred for 30 minutes and then macerated for 24 hours at 10°C. The liquid was separated using filter paper and evaporated in a rotary evaporator at 50°C. The extract was then placed in a dark glass bottle and stored in a refrigerator at 10°C.

Preparation of *Myrmecodiapendans* instant powder using foam mat drying

Egg white was added to the extract of *Myrmecodiapendans* in three different ratios (10%,15%, 20% w/w). The mixture was stirred using a mixer for 10 minutes until foam was formed. After that, maltodextrin was added in the same three ratios and mixed for 5 minutes. The mixer speeds were gradually increased from low to medium and then to high speeds. CMC 1% (w/w) was added and mixed again with a mixer for 1 minute. The foam was poured into a baking pan lined with aluminum foil, with a thickness of 2 mm. The drying process was carried out using a cabinet drying machine at 60 C for 7 hours. The resulting product was ground and sifted through a 60-mesh sieve and then stored in an airtight container.

Determination of characteristics of *Myrmecodia pendans* instant powder

Several tests were conducted to evaluate the physical, chemical, and sensory characteristics of *Myrmecodiapendans* instant powder. The physical tests measured lightness, dissolving speed, and total soluble solids. The chemical tests included determining the moisture content, total polyphenols, and antioxidant activity. Sensory characteristics were evaluated using a hedonic scale scoring method. To conduct the test, 5 grams of the instant powder were brewed with 50 mililiters of hot water at 90°C. The sample was then given a random 3-digit code and presented to 30 untrained panelists. The panelists were asked to rate the color, aroma, taste, and overall preference of the sample on a scale of 1 (dislike immensely) to 7 (like very much).

Analysis Data

The collected data was analyzed using Two Way Analysis of Variance at a significant level of $\alpha<0.05$ using SPSS version 16.0. If the data showed a significant difference, Duncan's Multiple Range Test was performed. The effectiveness index was used to determine the best treatment.

RESULT AND DISCUSSIONS

Physical characteristics of *Myrmecodiapendans* instant powder

Lightness. The lightness of *Myrmecodiapendans* instant powder ranged from 58.29±0.21 to 80.37±0.37 as shown in Table 1. Increasing the concentration of egg white and maltodextrin significantly increased the lightness of *Myrmecodiapendans* instant powder. The white color of egg whites and the incorporation of air during whipping, caused an increase in lightness due to an increase in egg white concentration. Similar results were found in tomato powder and *Hibiscus sabdariffa* L. powder. The lightness of *Myrmecodiapendans* instant powder also increased due to an increase in maltodextrin concentration. This was also observed in instant drink powder based on red beet extract and cranberry juice powder, which may be due to the reflection of the pale white color of maltodextrin.

Dissolving speed. The dissolving speed of *Myrmecodiapendans* instant powder ranged from 96.00±1.00 to 110.67±1.15 seconds, as shown in Table 1. The concentration of egg white and maltodextrin significantly affected the dissolving speed of *Myrmecodiapendans* instant powder. Increasing the concentration of egg white results in a more porous structure, making it easier for the instant powder to dissolve in water. Similar results were found in tomato powder and inulin of white sweet potato. On the other hand, maltodextrin has many hydroxyl groups that are hydrophilic. As a result, instant powder with a higher concentration of maltodextrin interacts more easily with water. Similar results were also found in mango powder, red guava juice powder, and cucumber powder drink.

Total soluble Solids. The total soluble solids of *Myrmecodiapendans* instant powder was found to range from 4.17±0.29 to 7.25±0.50 brix, as shown in Table 1. The total soluble solids of the powder increased significantly with an increase in the concentration of egg white and maltodextrin. Egg white contains albumin protein which is soluble in water. Higher concentrations of egg white were also observed to increase the total soluble solids in tomato powder and *Hibiscus sabdariffa* L. powder. Maltodextrin is composed of water-soluble D-glucose units, which also contributes to the increase in total soluble solids in the instant powder.

TABLE 1. Effect of egg white and maltodextrin concentration on the physical characteristics of *Myrmecodiapendans* instant powder

Egg White Concentration	Maltodextrin Concentration	Lightness	Dissolving speed (seconds)	Total soluble solids (brix)
10%	10%	58.29±0.21^{a}	110.67±1.15^{f}	4.17±0.29^{a}
	15%	58.89±0.45^{ab}	105.33±0.58^{d}	5.00±0.00^{ab}
	20%	59.53±0.54^{b}	98.00±1.00^{b}	6.00±0.00^{c}
15%	10%	67.82±0.59^{c}	108.33±0.58^{e}	4.83±0.29^{a}
	15%	68.19±0.55^{c}	102.67±0.58^{c}	5.37±0.29^{b}
	20%	69.34±0.93^{cd}	97.00±1.00a^{b}	6.50±0.50^{d}
20%	10%	79.64±0.34^{e}	107.67±1.53^{e}	5.17±0.29^{b}
	15%	79.75±0.29^{e}	101.00±1.00^{c}	5.83±0.58b^{c}
	20%	80.37±0.37^{e}	96.00±1.00^{a}	7.25±0.50^{e}

Different letters in the same column indicate significant differences ($\alpha < 0.05$).

Chemical characteristics of *Myrmecodiapendans* instant powder

Moisture content. The moisture content of *Myrmecodiapendans* instant powder ranged from 3.47±0.06 to 4.19±0.17%, as shown in Table 2. When the concentration of egg white and maltodextrin were increased, the moisture content of the powder decreased significantly. The surface area and porosity of the powder increases with higher egg white concentration, which makes it easier for water to evaporate and decrease the moisture content. This observation is like previous study on the inulin of white sweet potato. Maltodextrin also improves foam stability and accelerates water evaporation. Therefore, higher maltodextrin concentrations lead to a decrease in water content. Similar results were also observed in instant drink powder based on red beet extract and cranberry juice powder.

Total polyphenols. The total polyphenol content of *Myrmecodiapendans* instant powder ranged from 417.36±2.24 to 679.28±5.89 (mgGAE/g) as shown in Table 2. It has been observed that increasing the concentration of egg white and maltodextrin leads to a significant decrease in the total polyphenols of *Myrmecodiapendans* instant powder. It is worth noting that egg whites only contain a small amount of polyphenols, which is 0.019 (mgGAE/mL), whereas maltodextrin does not contain any polyphenols. The use of higher concentrations of egg white and maltodextrin results in a smaller proportion of *Myrmecodiapendans* extract, leading to a decrease in the total polyphenol content in the instant powder. This observation is consistent with similar findings in instant drink powder based on red beet extract, anthocyanins of black glutinous rice, and kecombrang powder.

Antioxidant activity. Antioxidant activity was tested using DPPH radical scavenging activity. *Myrmecodiapendans* instant powder exhibited antioxidant activity ranging from 45.87±1.06% to 65.98±2.07% as shown in Table 2. The concentration of egg white and maltodextrin significantly affected the antioxidant activity of *Myrmecodiapendans* instant powder. The antioxidant activity of *Myrmecodiapendans* instant powder increased with an increase in egg white concentration but decreased with an increase in maltodextrin concentration. Egg white protein components, specifically ovalbumin and lysozyme, have antioxidant properties, which enhance the antioxidant activity of instant powder. Maltodextrin increases the total solids in instant powder, which reduces its antioxidant activity. Similar results were observed in kecombrang powder, instant drink powder based on red beet extract, and mango powder.

TABLE 2. Effect of egg white and maltodextrin concentration on the chemical characteristics of *Myrmecodiapendans* instant powder

Egg White Concentration	Maltodextrin Concentration	Moisture content (%)	Total polyphenols (mg GAE/g)	Antioxidant activity (%)
10%	10%	4.19 ± 0.17^{e}	679.28 ± 5.89^{g}	61.17 ± 1.27^{g}
	15%	3.97 ± 0.08^{e}	596.07 ± 2.99^{e}	52.05 ± 1.77^{cd}
	20%	3.69 ± 0.08^{bc}	541.87 ± 8.63^{d}	45.87 ± 1.06^{a}
15%	10%	4.01 ± 0.06^{de}	655.06 ± 6.64^{f}	63.26 ± 1.78^{h}
	15%	3.84 ± 0.09^{d}	549.54 ± 3.62^{d}	55.18 ± 1.53^{d}
	20%	3.59 ± 0.06^{ab}	482.04 ± 3.62^{b}	47.20 ± 1.53^{b}
20%	10%	3.57 ± 0.01^{ab}	595.35 ± 2.20^{e}	65.98 ± 2.07^{h}
	15%	3.47 ± 0.10^{a}	504.46 ± 5.19^{c}	58.77 ± 1.90^{e}
	20%	3.49 ± 0.06^{a}	417.36 ± 2.24^{a}	50.35 ± 2.62^{c}

Different letters in the same column indicate significant differences ($p < 0.05$).

Sensory characteristics of *Myrmecodiapendans* instant powder

The concentration of egg white and maltodextrin significantly affected panelists' preference for color, aroma, and taste, but it did not significantly affect overall preference (as shown in Table 3). Panelists preferred instant powder that was neither too dark nor too light. Higher concentrations of egg white tended to reduce preference for aroma and flavor, while higher concentrations of maltodextrin tended to increase taste preference, possibly due to its sweet taste.

TABLE 3. Effect of egg white and maltodextrin concentration on the sensory characteristics of *Myrmecodiapendans* instant powder

Egg White Concentration	Maltodextrin Concentration	Color	Aroma	Taste	Overall
10%	10%	5.07 ± 1.01^{bc}	4.47 ± 0.66^{c}	3.67 ± 0.79^{a}	4.10 ± 0.70^{a}
	15%	5.17 ± 0.84^{c}	4.47 ± 0.68^{c}	4.40 ± 1.00^{c}	4.40 ± 0.89^{a}
	20%	5.17 ± 0.75^{c}	4.67 ± 0.67^{d}	5.03 ± 0.53^{d}	4.60 ± 0.87^{a}
15%	10%	6.90 ± 0.77^{e}	4.97 ± 0.60^{e}	5.07 ± 0.83^{d}	4.87 ± 0.51^{a}
	15%	6.80 ± 0.71^{de}	4.67 ± 0.51^{d}	4.97 ± 0.50^{d}	4.75 ± 0.64^{a}
	20%	6.73 ± 0.84^{d}	4.17 ± 0.71^{b}	4.53 ± 0.84^{cd}	4.67 ± 0.64^{a}
20%	10%	4.90 ± 0.80^{ab}	3.70 ± 0.74^{a}	3.63 ± 0.89^{a}	4.23 ± 0.57^{a}
	15%	4.83 ± 0.84^{a}	3.70 ± 0.79^{a}	4.10 ± 0.87^{b}	4.27 ± 0.58^{a}

Egg White Concentration	Maltodextrin Concentration	Color	Aroma	Taste	Overall
	20%	4.50±0.83[a]	3.63±0.60[a]	4.33±0.80[bc]	4.37±0.84[a]

Different letters in the same column indicate significant differences ($\alpha < 0.05$).

Conclusion

The concentration of egg white and maltodextrin used in the preparation of *Myrmecodiapendans* instant powder had a significant effect on all characteristics except for overall preference. The best treatment was achieved when using a 15% egg white and 10% maltodextrin concentration, resulting in instant powder with the following characteristics: lightness of 67.82 ± 0.59, dissolving speed of 108.33 ± 0.58 seconds, total soluble solids of 4.83 ± 0.29 brix, moisture content of 4.01 ± 0.06%, total polyphenols of 655.06 ± 6.64 (mgGAE/g), antioxidant activity of 63.26 ± 1.78%, color preference of 6.90±0.77, aroma preference of 4.97±0.60, taste preference of 5.07±0.83, and an overall preference of 4.87±0.51.

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