Antioxidative activity of aloe vera (*Aloe vera* var. *chinensis*) powder produced using maltodextrin and gum arabic as fillers

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Abstract. Aloe vera gel has the ability to function as an antioxidant due to its flavonoid content but it cannot be practically consumed in its fresh form. The purpose of this study was to produce aloe vera powder with a high antioxidant activity using maltodextrin and gum arabic as fillers, and performing the drying process in an oven at 50°C. This research was conducted with a completely randomized design with two factors namely the filler type and filler number, the fillers used were varied at 0%, 5%, and 10%. Moreover, the moisture content, total phenol, flavonoid, and antioxidant activity based on the ability to scavenge DPPH (1,1-Diphenyl-2-picrylhydrazil) radicals were determined for both the gel and dried form of the aloe vera. The results showed that the addition of fillers has a significant effect on the antioxidative activity such that more filler content was observed to have led to lower antioxidant activity. The use of 5% (w/w) of maltodextrin and gum arabic was discovered to have produced high antioxidant activity with Radical Scavenging Activity (RSA) of 15.01±1.50% and 14.44±1.58%, respectively. The IC50 value of powder with 5% maltodextrin and 5% gum arabic was found to be 239.20 mg/ml and 256.88 mg/ml, respectively.

1 Introduction

Aloe vera gel is the flesh of aloe vera leaf which is tasteless but functions as an antioxidant due to its flavonoid content. It is important to note that flavonoids have antioxidant properties which capture free radicals considered to be beneficial to human health. According to Li *et al*. [1], the flavonoids in *Allium mongolicum Regel* were able to increase the immune response and resistance to disease. Moreover, those present in dried-aloe vera were discovered to have the ability to reduce blood sugar in diabetic rats [2] while flavonoids such as quercetin, merycetin, and kaempferide have antiviral properties by inhibiting viral division or propagation [3]. However, it is practically impossible to consume aloe vera gel in fresh form and it has also been discovered to get easily damaged

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in this form, therefore, there is a need for its processing into more practical products for easier use.

Several studies have been conducted to produce a powdered form of materials containing flavonoids through the use of fillers. Setjadji and Sukasih [4] processed Shallot *(Allium cepa* var. *ascalonicum* L.) into powder using maltodextrin filler mixed with cassava starch and the results showed the maltodextrin was able to inhibit the decrease in the antioxidant activity of phenolic compounds. Wariyah and Riyanto [5] also processed aloe vera gel into powder through the use of 2.5% maltodextrin as a filler and the findings indicated a fairly high antioxidative activity of the powder with a Radical Scavenging Activity (RSA) value of 35.59±2.65%. Moreover, Hassani *et al.* [6] found the use of gum arabic as an encapsulating agent for gallic acid was able to increase the resistance of antioxidant activity during drying as evident in the RSA value of 25.4% in gallic acid and 35.6% in gallic acid nanocapsules with gum arabic. Therefore, it is necessary to evaluate the effect of adding maltodextrin and gum arabic to the processing of aloe vera powder.

The main method currently applied in producing aloe vera powder is the spray drier due to its ability to ensure high antioxidant activity of the product but it has been discovered to be less applicable and its low efficiency. Therefore, this study was conducted to produce aloe vera powder with a high antioxidant activity using maltodextrin and gum arabic as fillers, and performing the drying process in an oven at 50°C.

2 Materials and method

2.1 Materials

The raw material used in this study was aloe vera (*Aloe vera* var *cinensis*) leaves harvested at the age of 2 years and purchased from aloe vera farmers in Argodadi Village, Sedayu District, Bantul Regency, Special Region of Yogyakarta, Indonesia. The gum arabic and maltodextrin were purchased from Bratacho Chemika, while the chemicals for the antioxidant activity analysis with pro-analytical qualifications were from Merck (Darmstadt, Germany) except for the gallic acid, quercetin, and 1,1-Diphenyl-2-picrylhydrazil (DPPH) obtained from Sigma Aldrich Chemical Co. (St. Louis, MO, USA).

2.2 Method

This research was conducted in a completely randomized design using two factors which are the type and amount of filler. The maltodextrin and gum arabic used as fillers were varied at 0%, 5%, and 10% while the control treatment was dried-aloe vera without filler. Moreover, the processing of aloe vera powder was according to [7] and it was based on the stability of the antioxidant activity [8]. The aloe vera leaves were peeled and washed in running water to remove the skin and mucus, drained, cut into small pieces, and mashed with a blender (Philip CR 2115). This was followed by the addition of the predefined variations of maltodextrin and gum arabic to the gel slurry after which the mixture was dried in an oven (Memmert DIN 40050 IP 20) at a temperature of 50°C to a maximum moisture content of 12%.

Preparation of sample (fresh or powder) for chemical analysis referred to [9] with modification by using 80% ethanol as solvent [10]. Aloe vera leaves were peeled and washed simultaneously, and the clear gel sliced into 3 mm and then was mashed with blender. Two grams of mashed gel or powder were extracted with 20 ml of an 80% ethanol solution using a homogenizer at room temperature and protected from light for 1 h. The

solution was filtrated through Whatman paper No.2 and the supernatant was used for analysis of antioxidant activity, total phenolic content and flavonoid.

Chemical analysis was conducted on both the gel and powder of the aloe vera with focus on the moisture content evaluated using the static gravimetric method [11], total phenol on the extract calculated based on the gallic acid equivalent (GAE) using the Folin-Ciocalteu method, and flavonoid determined based on the quercetin equivalent through the colorimetric method [12]. Moreover, the antioxidant activity of the samples was determined based on the ability to scavenge DPPH radicals [9] through the use of a Spectrophotometer (Shimadzu UV mini-1240) at 517 nm to measure the decrease the reduction of the DPPH radical in the samples, while the IC50 value was determined with reference to [13].

2.3 Design Experiment

The experimental design was a completely randomized design and the difference between the treatments was determined using the F-test while the significant difference between samples was evaluated through the Duncan's Multiples Range Test (DMRT) [14]. The data were analyzed using SPSS for Windows 13.

3 Results and Discussion

3.1 Chemical properties of aloe vera gel

The results presented in Table 1 showed the moisture content of aloe vera gel was 99.07±0.24% and this is similar to the 98.93±0.06% reported by [15], while the phenol content was found by [16] to be 16.50 mg GAE/g extract. Moreover, [17] found the flavonoid content to be 24.99±2.42 mg/g extract. This means the values from this study were lower due to the differences in the varieties used as indicated by the fact that Aloe vera var chinensis was used in this present study and this is different from the Aloe vera barbadensis miller variety used in others. It is also important to note that there are variations in the method of extracting the samples. Moreover, the antioxidant activity of the aloe vera gel was recorded to be 15.73±0.22% based on the RSA value while [18] had 13.52.%. These values are influenced by the phenol content in each aloe vera variety such that a high value indicates higher phenol content.

Table 1. Moisture content, total phenol, flavonoid, and antioxidant activity of aloe vera gel

Component	Number
Moisture (%)	99.07±0.24
Total phenol (µg GAE/g dry matter)	470.16±40.31
Flavonoid (µg quercetin eq./g dry matter)	17.44±1.34
RSA (%)	15.73±0.22

3.2 Chemical properties of aloe vera powder

The chemical components of the aloe vera powder presented in Table 2 showed that the moisture content was significantly different as indicated by the values which ranged between 7.32% and 10.14%. This is analogous to the spice powder according to the

Indonesian National Standard (SNI 01-3709-1995) which is required to have a maximum of 12%.

Table 2. Moisture content, total phenol, flavonoid, and antioxidant activity of aloe vera powder

Aloe vera powder	Moisture (%)*	Total phenolic* µg/g dry matter	Flavonoid* µg/g dry matter	RSA* %
Dried-aloe vera (control)	8.22±0.65^{ab}	54.93±2.28^{d}	3.05±0.96^{b}	82.92±2.43^{d}
Added with 5% maltodextrin	7,32±1.26^{a}	10.36±1.18^{b}	0,19±0.12^{a}	15.01±1.50^{c}
Added with 10% maltodextrin	7,58±1.33^{a}	8.06±2.34^{a}	0.20±0.05^{a}	12.34±2.80^{a}
Added with 5% gum arabic	10,14±2.56^{b}	15.30±1.65^{c}	0.23±0.09^{a}	14.44±1.58^{c}
Added with 10% gum arabic	8,32±0.11^{ab}	13.76±1.03^{c}	0.40±0.13^{a}	13.31±2.43^{b}

*Mean in a column with similar superscript are not significantly different at α =0.05.

Table 2 shows the total phenols and flavonoids of the aloe vera powder were significantly different such that the addition of more filler was observed to be reducing the phenol content while there was no significant difference with the addition of 5 and 10% gum arabic and maltodextrin. Moreover, Ioannou *et al*. [19] reported that flavonoids are very sensitive to environmental conditions such as temperature, oxygen, light, and pH which have the ability to cause degradation and changes in the structure of antioxidant compounds, thereby, reducing the antioxidant activity.

According to Table 2, there are significantly difference between phenol content between filler adding samples. The results showed that gum arabic reduced the phenol and flavonoid lower than maltodextrin. This is in line with the findings of [20] that the Japanese quince powder (*Chaenomeles japonica*) with maltodextrin filler was more physically porous while the gum arabic is a hydrocolloid which functioned as a stabilizer [6] and this means it was able to increase the resistance to heat during drying. Moreover, the use of gum arabic in propolis extracts with high levels of phenols was found to be more effective in preventing phenol degradation than maltodextrin or inulin [21]. However, the total phenols and flavonoids of the aloe vera powder without filler were discovered to be the highest and this was associated with the proportionally higher content of the gel in the control treatment due to the absence of fillers.

3.3 Antioxidative activity of aloe vera powder

The antioxidant activity of the aloe vera powder was expressed as the Radical Scavenging Activity (RSA) which is associated with the ability to scavenge DPPH radicals as indicated in Table 2. The DPPH is represented with the purple color and the intensity was observed to be reduced as the antioxidants capture the radicals. This was further indicated by the absorbance values in Figure 1.

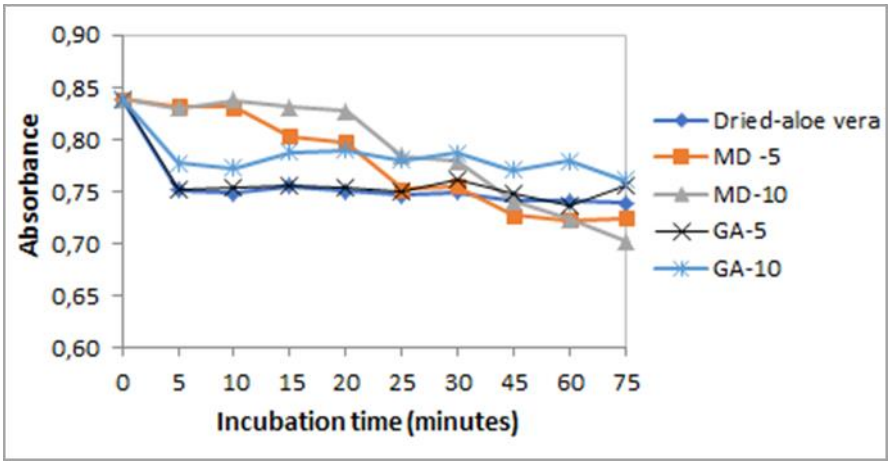

Fig 1. Profile of antioxidative activities of aloe vera powders during incubation.

Figure 1 shows the relationship between the incubation time and absorbance of aloe vera powder sample with the DPPH solution and the intensity of the purple color or absorbance at 517 nm wavelength was discovered to have decreased with the long incubation. A sharper decline, however, indicates the presence of higher antioxidant activity. Moreover, Table 2 shows the significant effect of the amount and type of fillers on the RSA value such that the addition of more fillers led to the reduction of the antioxidant activity. This was confirmed by the findings of [5] that the addition of more maltodextrin to the processing of instant aloe vera led to the reduction of the RSA and inhibition of lipid peroxidation based on the lower phenol content. It was also discovered that the use of 5% (w/w) gum arabic and maltodextrin produced a powder with high antioxidant activity as indicated by the RSA values of 14.44±1.58% and 15.01±1.50%, respectively. Meanwhile, the dried-aloe vera had the highest value due to the presence of a relatively higher content of phenols and flavonoids associated with the absence of fillers in the sample. This is also in line with the findings of [5] that dried-aloe vera has a higher antioxidation activity compared to samples with fillers.

The data in Table 2 showed the regression equation for aloe vera powder with high antioxidant activity after the IC50 value has been tested and this was observed for the sample with 5% maltodextrin filler and 5% Gum Arabic as indicated in Figure 2.

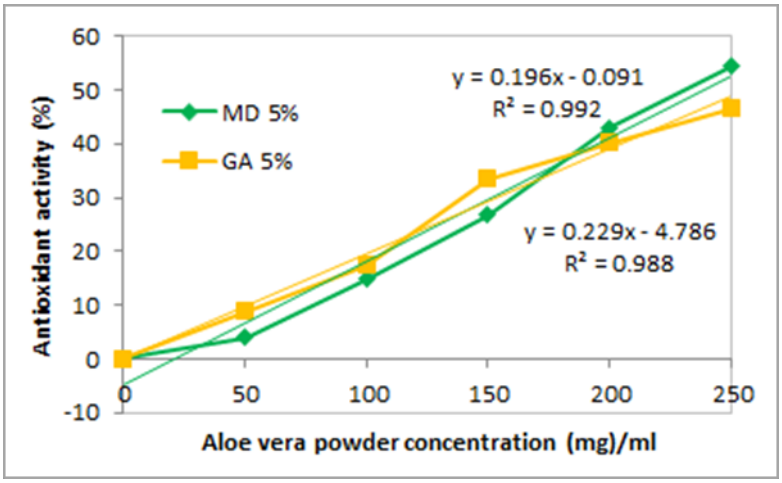

Fig 2. Relation between aloe vera powder concentration and antioxidant activity.

The regression equation was used to calculate the concentration of powder considered effective in scavenging 50% DPPH radicals or the IC50 value. According to Tristantini *et al.* [13], it is possible to calculate the IC50 value by substituting the value 50 for y to obtain IC50 (x) from the equation. Therefore, the results showed the IC50 value for aloe vera powder with 5% maltodextrin and 5% gum arabic was 239.20 mg/ml and 256.88 mg/ml, respectively. Meanwhile, the IC50 value of the water fraction (F_{water}) for aloe vera extract was found by [16] to be 433 mg/L (0.433 mg/ml) and this is lower than the values obtained in this study. This means its antioxidant activity was higher based on the fact that a lower IC50 value usually indicates a higher antioxidant activity. This difference was associated with the extraction of the phenol in this study into 3 high-content fractions including the dry fraction from F_{water} which had 16.5 mg/g extract and this shows the antioxidants content was high while the IC50 value was low.

4 Conclusion

The use of 5% maltodextrin or gum arabic filler in processing aloe vera powder in an oven at a temperature of 50°C was able to produce a product with high antioxidant activities which can be used in small functional food industries.

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