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Chemical Characteristics of *Aloe Vera* and *Aloe Saponaria* in Ulsan Korea

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Abstract

The Aloe saponaria plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. On the other hand, Aloe saponaria also contain anti nutrition compounds namely saponin which leads negative effect. Other kind of Aloe known is Aloe vera. The aim of the study was to investigate the saponin content from each part of Aloe plant to maximize it benefits and advantages. In order to know the higher saponin content, this study was comparing between Aloe saponaria and Aloe vera. The saponin content were analyzed from five part of Aloe leaf such as tip of the leaf, middle of the leaf, bottom of the leaf, leaf skin and leaf flesh. To do this, following are done. Total saponin content was identified by extraction. The procedure was performed by modifying the four thermal processing methods by Xu and Chang, 2009. The saponin analysis shows that the skin (S) of the Aloe leaf contains highest concentration of saponin compare to the other part, on both of Aloe species leaf. Those are 1.519±0.048 mg/g for Aloe saponaria and 1.212±0.035 mg/g for Aloe vera respectively. The highest water content obtained in mesophyll tissue (IS). Up to 98% the mesophyll tissue contains with water.

Keywords*: Aloe saponaria, Aloe vera, saponin, medicinal plant*

1. Introduction

The Aloe is an original species from South Africa., it has been used by peoples for centuries. The Aloe can be found in warm, arid climates throughout the world such as Africa, Asia, and Southern Europe, especially in the Mediterranean regions. *Aloe saponaria* is different species with *Aloe vera*; both of them are among 400 species of plants in the *Aloe* genus.

Generally the *Aloe* has arid plant characteristic with modified leaf anatomy. The spiky tongue shape of *Aloe*, including in *Aloe saponaria* and *Aloe saponaria* are composed such as saponins, aluin, ligin, antraquinones, vitamins and minerals [1-2]. The epidermis of *Aloe* leave has a trick cuticle and central of bulk of the leaf

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consisted with Aloe gel wrapped by mesophyll tissue. Saponin is one of important compound in *Aloe* leaf. Many evidences exhibit the advantages of saponin in biological activities, such antiviral and antidiabetic. It explained the reason why many culture used Aloe to gain their benefit for human health.

Saponins can enhancing cell membrane permeability, regulating nutrient uptake in the intestine, reducing protein digestibility and decreasing serum cholesterol. Saponins cause a reduction of blood cholesterol by preventing its re-absorption [3]. Another research of Aloe saponaria showed the benefit of saponaria against tumor cell. Saponins have antitumor and anti-mutagenic activities and can lower the risk of human cancers, by preventing cancer cells from growing [4]. Saponins also seem to help our immune system and to protect against viruses and bacteria [5]. In the experiment with rat, it was feeding with Parkia biglobosa. It contains with saponins and impacting in lipid lowering by preventing increase in serum cholesterol, triglyceride, low density lipoprotein (LDL) and decrease in high density lipoprotein (HDL). Accordingly, it has benefit such as reduced risk of heart diseases [6].

The saponins extraction from Aloe leaf was studied by [7]. The chemical composition of saponins and aluin from Aloe vera leaf was explained. It was only describe the general part of Aloe leaf contained with saponin. In other word, that research does not specify the exact saponins percentage on each part of the leaf.

This paper proposes a detail analysis of saponins concentration on each part of the *Aloe* leaf and also was comparing the saponin concentration between *Aloe saponaria* and *Aloe vera*. It was important thing, because both of them are consumed freshly. Identifying the leaf part with highest saponins concentration was important. By understanding saponins concentration, benefits and advantages of *Aloe* can be optimized.

2. Materials and Method

2.1. Sample Preparation

The materials were used *Aloe saponaria* and *Aloe vera*. Both of them were supplied by DoYoung Aloe Company, Ulsan city Republic of Korea and storage in the refrigerator until the experiment began. To prepare the samples, the *Aloe* washed by tap water. The *Aloe* divided into five part observation area and also gave them with deferent code respectively, which are tip of the leaf (H), middle of the leaf (M), bottom of the leaf (B), leaf skin (S) and leaf flesh (IS).

Using a commercial blender, the samples of *Aloe* were chopped and mixed into homogeneous solution to analyze its saponin, pH and sugar (brix) content. The part of *Aloe* that used for this experiment can be seen in the Figure 1.

2.2. Extraction of Saponin Content from Aloe Saponaria Leaf

Extraction of saponin procedures were performed by modifying the four thermal processing methods by Xu and Chang, 2009. Briefly, 0.5g of *Aloe* samples in Figure 2 (a) were defatted with 10mL of petroleum ether by shaking for 4h, and then the residues were extracted in Figure 2(b) by 10mL of 80% aqueous methanol for 4h. The extracts were measured for 0.3mL as a samples, 0.3mL of freshly *Aloe* juice were prepared by 8% vanillin solution (in ethanol), and 3.0mL of sulfuric acid were vortexed for 5-10s.

Then the mixture solution were incubated in a water bath at 60°C for 20min and cooled down in ice-cold water until the temperature decreased. It can be seen in the Figure 2(c). Absorbance at 544nm was recorded using spectral photometer in Figure 2(d). The results were expressed as mg of saponin equivalent per gram of sample on a dry weight (mg/g DW) basis from a standard curve of different concentrations of

crude saponin. Every sample solution was injected in triplicate, and the contents of the analytes were determined from the corresponding calibration curves. According the calibration curve equation, the amount of saponin in each sample can be calculated accurately.

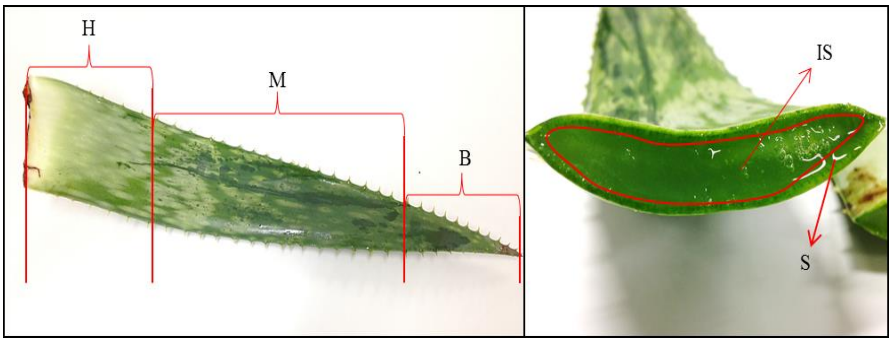
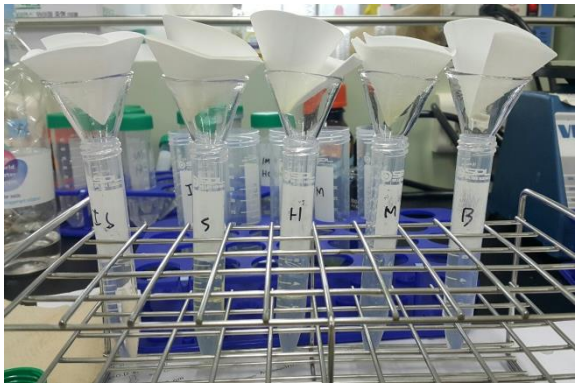
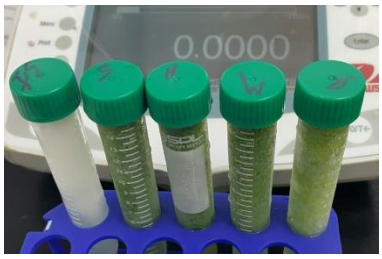


Figure 1. Parts Of *Aloe*; Tip Leaf (H), Middle Leaf (M), Bottom Leaf (B), Leaf Skin (S) and Leaf Flesh (IS)

(a)



(b)



(c)

(d)

Figure 2. (a) Measuring Of 0.5 Grams Aloe Saponaria Samples, (b) Extraction Process, (c) Cooled Samples, (d) Spectral Photometer

2.3. pH Value Analysis

The pH value analyses were conducted by digital pH meter ISTEK, Inc. (Republic of Korea) type pH-250L with ±0,002 relative accuracy and pH range between -20.000 to 19.000. The pH measurement device consisted with two parts, rod sensor and controller devices. The rod sensor design was same as acid sensor in general, tabular shape with liquid inside it. The controller device equipped with

digital display to show the pH reading. The pH represented the aqueous solution acidity or alkalinity.

2.4. Sugar Content (% brix) Analysis

Brix analysis of sugar content was conducted by using a portable digital refractometer ATAGO co., Ltd (Japan), brix range 0-53% with resolution 0,1% brix/0,1˚C and accuracy ±0,2%brix/±1˚C, measures of relative sugar content in the *Aloe saponaria* and *Aloe vera* were determined. Extract of sample were dropped and placed onto the refractometer slide and pushing the light button to measure the brix degree. The result of brix was shown in the digital display in several second. Samples of extract *Aloe* were analyzed in three times replication to determine an average brix value for each sample. ATAGO portable refractometer can be seen in the Figure 3.

Figure 3. ATAGO Digital Portable Refractometer

2.5. Water Content Analysis.

To find the water content of *Aloe*, the small piece of samples were taken from each leaf part. The sample which is taken has ± 0.5 grams of weight averagely. There are three samples from each leaf part, this purposed for water content repetition measurement. Each sample was scaled with Sartorius precision weighing with 0.1 mg scale division. Each sample was evaporated the water content and measured the weight with two hours intervals. Totally four hours needed to evaporate the water from *Aloe*. In the final state, the dry masses of *Aloe* were checked with precision scale weighing. Comparing the mass of evaporated water with initial weight and multiplied with 100% to gain the moisture content of *Aloe*. A force convection dryer was used to evaporate the water content. The device can be seen in the Figure 4.

Figure 4. Evaporating Water Content Using Force Convection Dryer

3. Results and Discussion

In this section, the experimental results of saponin extraction from *Aloe saponaria* and *Aloe vera* using proposed method are presented. For pH, sugar and water content was done with *Aloe saponaria* only. It consider that value can be represented the pH and sugar content on *Aloe vera* also. The present study carried out on the *Aloe Saponaria* revealed the presence of medicinal active constituents. The phytochemical active compounds of *Aloe Saponaria* were qualitatively analyzed and the results are presented in Table 1 below. In analysis of Tannin compounds brownish green color developed to indicate the presence of Tannin. Similarly based on the presence or absence of color change indicates positive and negative results are indicate. In this screening process Tannin, Saponin, Flavonoids and Terpenoids gave positive results and Phlobactanins and Steriods gave negative results.

Table 1. Qualitative Analysis of Photochemical Al Components

Phytochemical components	Presence/Absence
Tannin	(+)
Phlobatannins	(-)
Saponin	(+)
Flavonoids	(+)
Steriods	(-)

+ = Presence, - = Absence

The quantitative value in *Aloe saponaria* leaf were can be shown in Table 2 below, this value can be used for standard condition to measure the saponin content contain in the part of *Aloe saponaria* leaf.

Table 2. Quantitative Analysis for Aloe Saponaria Leaf Form Whole Parts

Aloe saponaria condition	Value
Initial sugar content	± 0.2 %
pH level	± 4.8 pH
Temperature	± 21.3°C

Standard calibration curve in Figure 7 was plotted by taking absorbance of different concentrations of the solution in Figure 5. The value of R square (R^2) for standard saponin content in *Aloe saponaria* was 0.999. The R^2 indicating the fitness of regression line. While the value reaches 1, the line fits perfectly, and 0 indicates that the line does not fit the data at all. In a general form, R^2 can be seen to be related to the unexplained variance, since the second term compares the unexplained variance (variance of the model's errors) with the total variance (of the data). According the statistic regression, the absorbance equation was equal with Y = 3.0817 X + 0.0063. It has 0.000712 of residual error.

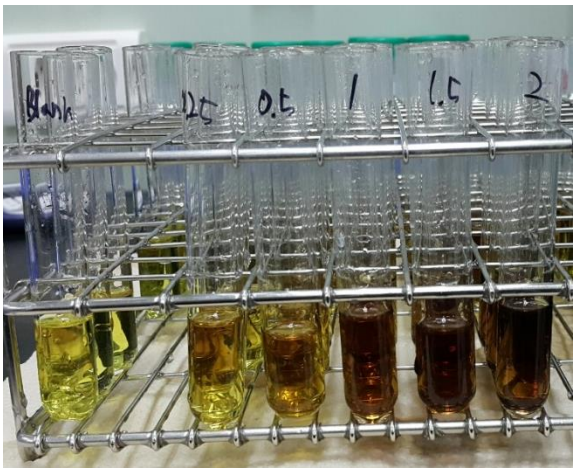


Figure 5. Standard Solution for Measuring Saponin Content

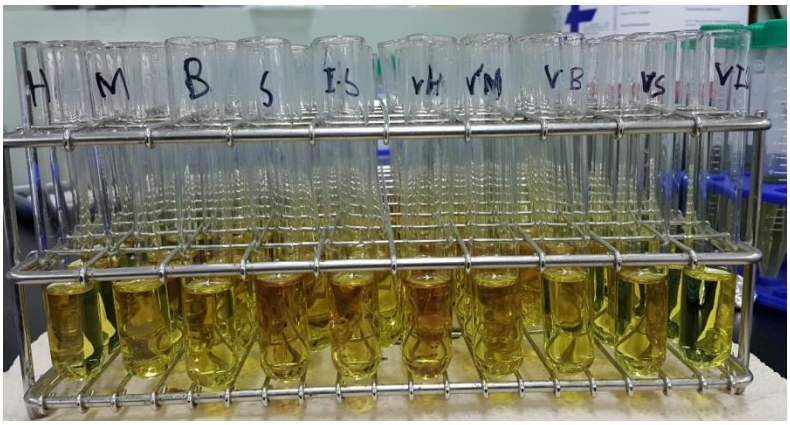


Figure 6. Solution of *Aloe Saponaria* and *Aloe vera*

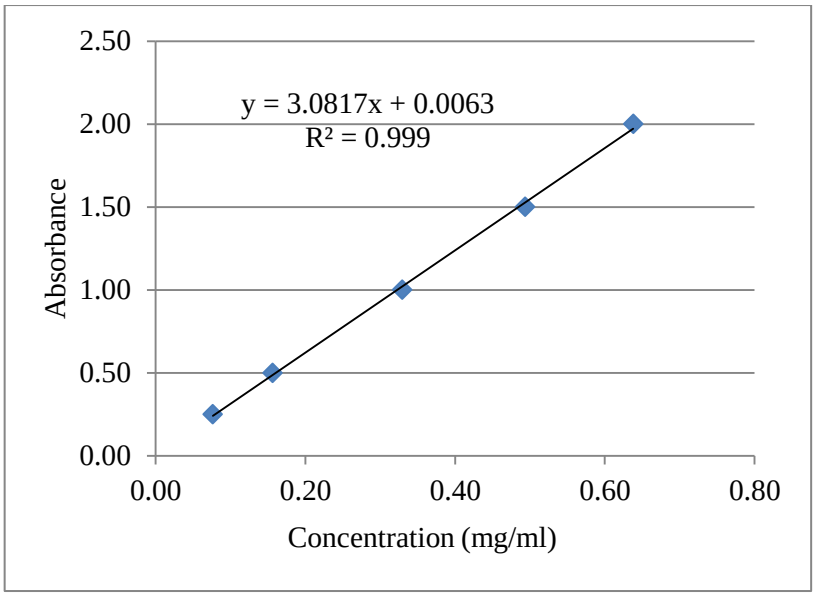


Figure 7. Standard Calibration Curve for Total Saponin Content

The different total saponin content obtained from extraction each part of *Aloe Saponaria* and *Aloe vera* leaf using the proposed method is shown in Table 3. The absorbance was measured according the samples solution in Figure 6. We studied that the minimum saponin content is obtained from the leaf flesh (I.S) of *Aloe saponaria* 0.638±0.064 mg/g and 0.253±0.012 mg/g of *Aloe vera* which are the biggest part of the leaf. The middle of leaf (M) does not significant different with leaf flesh in the saponin content.

Those are 0.876±0.007 mg/g and 0.579±0.003 mg/g for *Aloe saponaria* and *Aloe vera* respectively. The bottom (B) and the tip (M) of leaf have almost similar amount of saponin content which is 1.132±0.026 mg/g and 1.083±0.020 mg/g for *Aloe saponaria*. In *Aloe vera* were 0.806±0.013 mg/g and 0.689±0.029 mg/g. The highest saponin content can be obtained from the leaf skin (S), which is 1.519±0.048 mg/g in *Aloe saponaria* and 1.212±0.035 mg/g in *Aloe vera*. Comparison between total saponin content contain in *Aloe saponaria* and *Aloe vera* leaf in whole parts also can be shown in Figure 8.

Table 3. Total Saponin Content In 1 Gram of Each Part *Aloe Saponaria* Leaf

Leaf Part	*Aloe saponaria* (mg/g)	*Aloe vera* (mg/g)
Bottom of the leaf (B)	1.132 ± 0.026	0.806 ± 0.013
Middle of the leaf (M)	0.876 ± 0.007	0.579 ± 0.003
Tip of the leaf (H)	1.083 ± 0.020	0.689 ± 0.029
Leaf skin (S)	1.519 ± 0.048	1.212 ± 0.035
Leaf flesh (I.S)	0.638 ± 0.064	0.253 ± 0.012

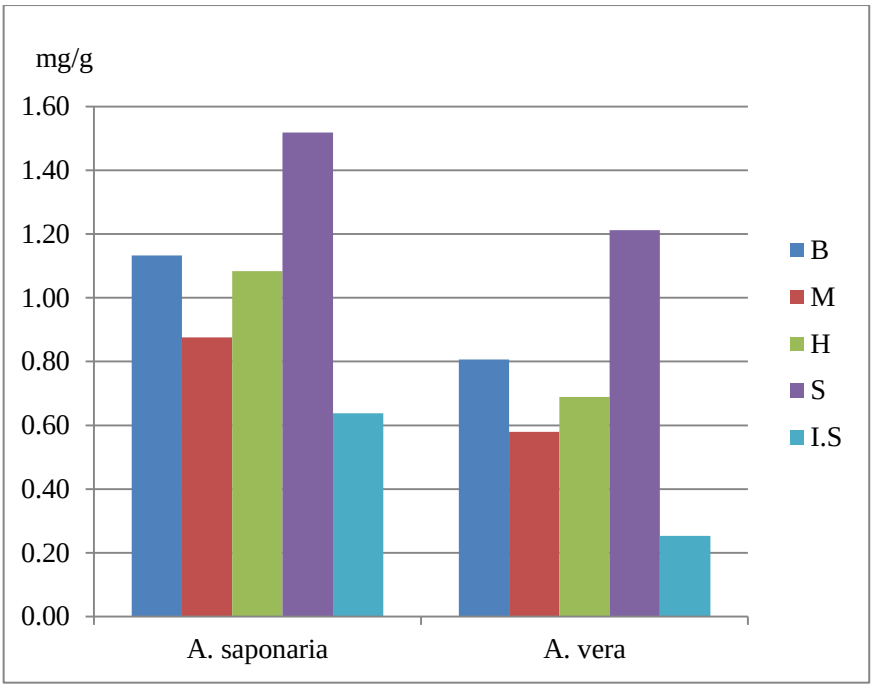


Figure. 8. Total Saponin Content In 1 Gram of Each Part Aloe Leaf

Since the highest saponin content can be obtained from the tip (H) and the skin (S) part of *Aloe* leaf, to maximize the benefit of *Aloe*, only those parts are recommended to be used as source of saponin. Exception to *Aloe vera*, which the skin has bitter taste characteristic. It caused by the mesophyll tissue and leaf skin has more thickness compare to *Aloe saponaria*. The leaf flesh can be used for the other applications such as moisture gel for cosmetics, medical treatment for thermal injury, *Aloe* juice, etc.

The water content on each part of Aloe leaf has measured. The 0.5 grams of samples were dried using force convection dryer. Total time to evaporate the water and gain the dry mass of aloe was four hours. The weights of samples were measured with two hours intervals. The water content in Aloe is very high, up to 90% of Aloe leaf contains with water. It can be seen in the Table 4. The highest water content was obtained in leaf flesh or mesophyll tissue. This gel formation act like water reservoir and help the plant to survive in the arid area, which the water is difficult to be found. This part usually consumed and processed to be juice or syrup.

Table 4. Water Content of Aloe Leaf

Leaf Part	Water Content (%)
H	95.516±1.412
M	95.769±0.086
B	95.456±0.294
S	93.809±0.361
IS	98.823±0.035

4. Conclusions

This paper has revealed the presence of saponin in each part of *Aloe* leaf. Total saponin content was identified by extraction. The procedure was performed by modifying the thermal processing methods. The result confirmed that the amount of

saponin on the skin is highest. Both of *Aloe* species performed 1.519±0.048 mg/g in *Aloe saponaria* and 1.212±0.035 mg/g. the lowest saponin were obtained in leaf flesh (IS) which are confirmed 0.638±0.064 mg/g and 0.253±0.012 mg/ for *Aloe saponaria* and *Aloe vera* respectively. It showed that the skin of the *Aloe* leaf contains highest concentration of saponin compare to the other part of *Aloe* leaf. In other hand, up to 98.823±0.035% of leaf flesh contain with water. This part has the highest water content in the *Aloe* leaf part.

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