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ALOE VERA POWDER PROPERTIES PRODUCED FROM ALOE CHINENSIS BAKER, PONTIANAK, INDONESIA

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Abstract

Aloe vera powder was produced from gel of *Aloe Chinensis Baker* from Pontianak, Indonesia. The effect of drying air inlet temperature to produce *Aloe vera* powder from *Aloe Chinensis Baker* was studied. Gel of *Aloe Chinensis Baker* was crushed, evaporated, mixed with maltodextrin and dried in a *Shimadzu* counter current spray dryer.Dryingair inlettemperature in spray dryer was varied110°C, 120°C, 130°C and 140°C. The raw material was analysed such as proximate, amino acid, calcium, magnesium, phosphor, lead, sodium, potassium and mangan. The product, *Aloe vera* powder was analysed such as appearance, colour, water content, pH, density, microbiology and the result was compared with *Aloe vera* powered commercial from Terry Labs. The active compounds on *Aloe vera* powder was analysed using LC-MS. InLC-MSdetectedcompoundsin the form especiallyionsM+H, sothere areadditionalmolecules intoionsin theM+1.This method was applied to determine five compounds in evaporated *Aloe vera* gel, *Aloe vera* powder (with drying inlet air temperature 110°C, 120°C, 130°C, 140^0C). Aloin A and B, aloenin (B), aloesin and chrysophanol could be detected in all of samples. Aloe-emodin could not be detected in all samples. Aloeresin *A* could be detected in evaporated*Aloevera* gel, *Aloe vera* powder (with drying inlet air temperature 110°C, 120°C). The result was shown that the optimum air drying air inlet temperature was 120^0C to produce *Aloe vera* powder which all of phenolic compounds of *Aloe vera*powder can still be maintained.Some of quality parameters such as water content, pH, solubility, colour, appearance, and microbiology are compliance with the standard of available commercial product.

Keywords: *Aloe Chinensis Baker*, Aloin A and B, Aloe-emodin, Aloenin (B), Aloesin, Aloinoside A and B, AloeresinA, Chrysophanol.

1. Introduction

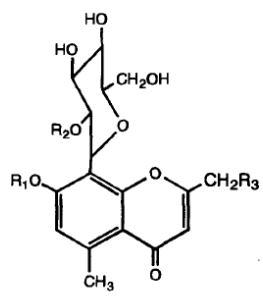
Aloe vera is one of the few herbal medicines widely used in Western society, with the manufacturing of *Aloe vera* extracts being one of the largest botanical industries worldwide [1, 2]. In 2004, the value of the *Aloe* industry was estimated to be US$125 million for the cost of the raw *Aloe* material and US$110 billion for finished *Aloe*-containing products. *Aloe vera* is used in the cosmetic, food, and pharmaceutical industries. In the cosmetic and toilet industry, it is used as a base material for skin moisturizers, soaps, shampoos, sun lotions, makeup creams, perfumes, shaving creams, bath aids, and many other products[1, 3]. The food industry uses *Aloe* in the manufacture of functional foods, especially health drinks, and as a bitter agent [4]. Pharmaceutical products are available for topical applications (gels and ointments) and oral use (tablets and capsules) [5].

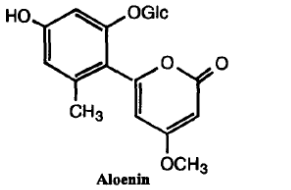
The composition of *Aloe vera* extracts is varying due to the plant variety, climatic and seasonal variations, and the age of the plant [1]. However, the processing method has the largest effect on the number and amount of active ingredients in a product [6]. The commercial production process of *Aloe vera* products typically involves crushing, grinding, or pressing of the whole *Aloe vera* leaf to produce juice, followed by various steps of filtration and stabilization to achieve the desired extract [1]. This method provides ease of processing and higher efficiency in the recovery of the solids [7], but it can result in a product that contains little or no active ingredients [1]. In an analysis of 18 commercial *Aloe vera* products, only 9 exhibited quantifiable amounts of mucilaginous polysaccharide [8]. Only three of the nine commercial *Aloe vera* gel powders sourced from leading international suppliers demonstrated satisfactory amounts of the mucopolysaccharide *Acemannan* [9]. Variable polysaccharide content in *Aloe vera* has been attributed particularly to heating the plant extract to >60°C, which results in significant changes in molecular weight [6]. A further issue with the commercial production process is that during the commercial extraction of *Aloe vera* gel, it is virtually impossible to prevent the contamination by leaf exudates [1]. Finally, the adulteration of *Aloe vera* products using fillers such as maltodextrin, glucose, glycerin, and malic acid represents a major concern for the *Aloe vera* market [9]. As a counter to such misrepresentations in the industry, the International Aloe Science Council developed a certification program that validates the quality and quantity of *Aloe vera* for approved commercial products.

In West Kalimantan, especially Siantan Hulu area, Pontianak, Indonesia*Aloe vera* Plant(*Aloe veraChinensis Baker*)is an alternative productive crop as an agricultural commodity crop despite the vegetables [10,11]. Aloe genus (*Liliaceae*) constitutes about 600 species and these are known to occur mainly in Africa. *Aloe* is an important plant and widely used as folk medicine. Two products are obtained from *Aloe* leaves, both of which have been medicinally used for centuries. The fraction called gel of parenchyma cells, which is colorless and tasteless, has been used particularly for treatment of skin diseases [2]. In addition to a large amount of water this gel mainly contains polysaccharides. The yellow exudate from the inner epidermal cell layers is well known for its purgative activity, and phenolic compounds are abundantly contained in it [12]. Purgative principles from *Aloe* have been identified as an anthrone-C-glucosyl, barbaloin (aloin A) and homonataloin. In Japan, A. Arborescens Miller var. Natalensis Berger is used as a folk remedy, and A, barbadensis Miller (*Aloe vera*) attracts much attention as a health food. Aloesin (formerly named aloeresin B)

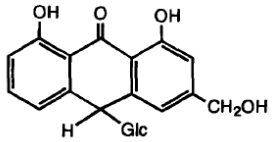
barbaloin and the related compounds were isolated from the leaves of many *Aloe* species, and the antimicrobial activity and cathartic effects were confirmed [9].

Several paper on high-performance liquid chromatographic (HPLC) determination of barbaloin were reported, but only few describe the simultaneous determination of anthrone and chromone constituents [13]. Structures of aloesin, barbaloin and isobarbaloin (aloin B), aloenin, 2'-O-feruloylaloesin, aloe-emodin, aloeresin A (*p*-coumaric acid ester of aloesin), 8-C-Glucosyl -7-O-methyl-(S)-aloesol, isoaloeresin D and aloeresin E are shown in Fig. 1.

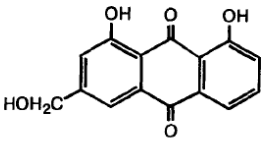




Aloenin



Isobarbaloin (10*S*)
Barbaloin (10*R*)



Aloe-emodin

	R_1	R_2	R_3
Aloesin	H	H	$COCH_3$
8-*C*-Glucosyl-7-*O*-methyl-(*S*)-aloesol	CH_3	H	$CH(OH)CH_3$
Aloeresin A	H	*p*-coumaroyl	$COCH_3$
Isoaloeresin D	CH_3	*p*-coumaroyl	$CH(OH)CH_3$
2'-*O*-Feruloylaloesin	H	feruloyl	$COCH_3$
Aloeresin E	CH_3	cinnamoyl	$CH(OH)CH_3$

Fig. 1. Structures of *Aloe vera* Compounds.

In this research, *Aloe vera* powder was produced from gel of *Aloe Chinensis Baker* from Pontianak, Indonesia. The effect of drying air inlet temperature to produce *Aloe vera* powder from *Aloe chinensis Baker* was studied.The purpose of this research is to study the optimumdrying air inlet temperature to produce*Aloe vera* powder which all of phenolic compounds of *Aloe vera*powder can still be maintained.

2. Experimental

2.1. Materials

Main material used was *Aloe veraChinesis Baker* leaves from Pontianak. The chemicals used to produce *Aloe vera* powder was maltodextrin.

2.2. Preparation of sample *aloe vera* powder

The procedures to produce *Aloe vera* powder are:

a. Peeling and taking the gel.
   In this stage, it was done by manual.

b. Crushing the gel and filtration.

   The gel was crushed using blender and the filtration was done by manual filter press.

c. Evaporation.

   The filtrate of *Aloe vera*outcome from filtration was evaporated (40 times) using rotary vacuum evaporation capacity 20 L to get core of gel. One batch was conducted to evaporate 8 Lfluid at temperature 35 – 40^{o}C and vacuum condition (75 – 100 mbar).

d. Adding microencapsulation materials.

   After the evaporation stage, the core of *Aloe vera* was mixed with filler, maltodextrin and it was mixed well using homogenizer with 1:1 composition the core and maltodextrin.

e. The Drying Process using Spray dryer.

   Inthis research, the drying was conducted using *Shimadzu* counter current spray dryer. The hot air was introduced co-current with feed stream. In this stage, it was obtained the optimum variable process for drying to get active compound still maintained.The optimization was conducted to obtain the optimum drying air inlet temperature corresponding to desired quality of product or product in the market. To approach this, the drying air inlet temperature was varied: 110^{o}C, 120^{o}C, 130^{o}C, and 140°C.

2.3. *Aloevera* powder analysis

The raw material was analysed such as proximate, vitamin A and C, Calcium, Magnesium, Phosphor, Fe, mangan, Sodium, Potassium and total dissolved solid. The product, *Aloe vera* powder, was analysed such as water content, pH, microbiology, density, solubility, colour, appearance and the result was compared with *Aloe vera* powered commercial from Terry Labs. The active components on *Aloe vera* powder wereanalysed using LC-MS. The equipment used were gel crusher, filter, evaporator, homogenizer, centrifugal separator, and spray dryer.

A procedure has been developed for determination of phenolic compounds of *Aloe vera* Powder. Aloin A and B, aloe-emodin, aloenin (B), aloesin, aloinoside A and B, aloeresin A and chrysophanol are phenolic compounds of *Aloe vera* powder. *Aloe vera* powder was extracted with water multiple times (100 mg *Aloe vera* powder/1 ml water), was centrifuged and then was filtered. Filtrates were analysed by reversed-phase liquid chromatographymass spectrometry employing UV-Vis detection (254 nm) and mass spectrometry detection. The samples were separated with a symmetry C 18 5 um, 4.6 mm × 150 mm column by linear gradient elution using water-acetonitrile as the mobile phase at a flow-rate of 1,0 ml/min. This method was applied to determine seven compounds in Evaporated *Aloe vera* gel, *Aloe vera* powder (with air dryingair inlet temperature 110°C, 120°C, 130°C, 140°C). InLC-MSdetectedcompoundsin the form especiallyionsM+H, so there areadditionalmolecules intoionsin the M+1. Name of compounds, molecular formulas and molecular mass are shown in Table 1.

Table 1. Name of *Aloe vera*Compounds and Molecular Mass.

Name of Compounds	Molecular Formulas	Molecular Mass (exact mass, monoisotop)
Aloin A and B (barbaloin and isobarbaloin)	$C_{21}H_{22}O_5$	418.1264
Aloe-emodin	$C_{15}H_{10}O_5$	270.0528
Aloenin (B)	$C_{19}H_{22}O_{10}$	410.1213
Aloesin	$C_{19}H_{22}O_9$	394.1264
Aloinoside A and B	$C_{27}H_{32}O_{13}$	564.1843
Aloeresin A	$C_{28}H_{28}O_{11}$	540.1632
Chrysophanol	$C_{15}H_{10}O_4$	254.0579

3. Results and Discussion

3.1. Properties of *Aloe vera*gel

In this study, the *Aloe vera* gel was analysed by 3 times repeated sample of fresh 7 - 8 months old *Aloe vera*, from Siantan, Pontianak, West Kalimantan Barat. The result of *Aloe vera* gel was shown in Table 2.

Table 2. The Result of Properties of *Aloe Vera* Gel (Raw Material).

Compounds	Unit	Content
pH		4.0 – 4.5
Water	%	99.51
Fat	%	0.067
Carbohydrate	%	0.043
Protein	%	0.038
Vitamin A	IU	4.594
Vitamin C	mg	3.4
Calsium	ppm	458
Phosphor	ppm	20.10
Fe	ppm	1.18
Magnesium	ppm	60.8
Mangan	ppm	1.04
Potassium	ppm	797.0
Sodium	ppm	84.4
Total dissolved solid (TDS)	%	0.490

3.2. Properties of *Aloe vera* powder

The *Aloe vera* powder from fresh *Aloe vera*leaves was analysed in term of the microbiology, water content, density, solubility, pH, colour, appearance and active compounds using LC-MS. The properties of *Aloe vera* powder obtained from the research for drying air inlet temperature variation was described in Table 3. It was compared with the standard commercial *Aloe vera* powder from Terry Labs.

Table 3. TheProperties of *Aloe vera*PowderObtained.

Compounds	***Aloe vera* Powder 1 (140 °C)**	***Aloe vera* Powder 2 (130 °C)**	***Aloe vera* Powder 3 (120 °C)**	***Aloe vera* Powder 4 (110 °C)**	***Aloe vera* powder Spray dried gel (Terry Lab`s Product)**
Water content (% w/w)	2.88	4.04	4.89	4.89	8% max
pH	4.98	4.99	4.97	4.98	3,5 – 5,0
Microbiology (cfu/g)	96	97	97	98	< 100 cfu/g
Density (g/ml)	0.99	0.99	1.00	1.00	0,990 – 1,010
Solubility (minute)	2.26	1.93	2.94	2.94	5 minute
Colour	Beige white	Beige white	Beige white	Beige white	Beige White
Appearance	*Fine Crystalline powder*	*Fine Crystalline powder*	*Fine Crystalline powder*	*Fine Crystalline powder*	*Fine Crystalline powder*

In general, the resulting product has met most of the parameters and specifications of commercial *Aloe vera* powder on the market such as water content, solubility, colour, pH, appearance and microbiology. Table 3 shows that drying air inlet temperature with higher temperatures resulting in *Aloe vera* powder products with microbiology (cfu/g)levels are lower even though the four variables still eligible (<100 cfu/g).

While the products almost the same density compared to available commercial products. This might be due to the method of testing using different methods so the result is somewhat different. The testing methods used packed density. In the drying process (spray dryer), the decreasing of hot air inlet temperature did not affect the increase of water content significantly. In fact, water content tended to be stable of 2-5%. This has a positive effect for the quality of product in which the active component microencapsulated was relatively stable for lower temperature of dryer. A LC-MS method was used to get chromatography analysis. It was described the chromatography analysis of Absorbance at 254 mm for *Aloe vera* gel powder concentrates from evaporation process, the *Aloe vera* powder using 110^0C, 120^0C, 130^0C, 140^0C drying air inlet temperature. The LC-MS result for all samples (aloin A and B) was presented in Figs. 2-6. Extracted chromatograms and mass spectral data (*aloenin* B, *aloesin*, *aloeresin* A and *chrysophanol* are shown in *Appendix A*.

Determination of phenolic compounds of *Aloe vera* powder is shown in Table 3. *Aloin* A and B, *aloenin* (B), *aloesin* and *chrysophanol* could be detected in all of samples. *Aloe-emodin* could not be detected in all samples. *Aloeresin* A could be detected in Evaporated *Aloe vera* gel, *Aloe vera* powder (with drying air inlet temperature 110^0C, 120^0C). Based on data, the maximum drying air inlet temperature was 120^0C to produce *Aloe vera* powder which all of phenolic compounds of *Aloe vera* powder can still be maintained.

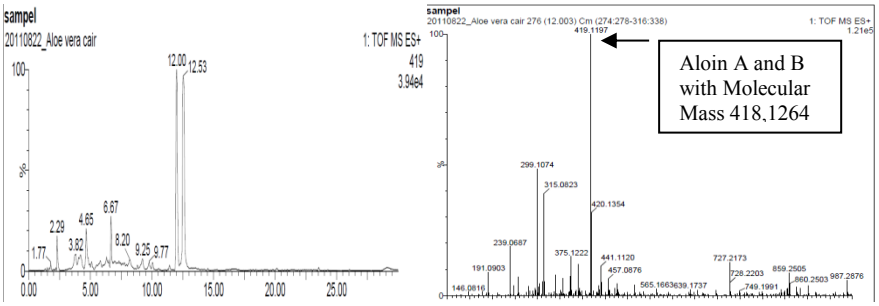


Fig. 2. Extracted Chromatograms and Mass Spectral Data (*Aloin* A and B) of *Aloe vera*Extract Produced from Evaporated.

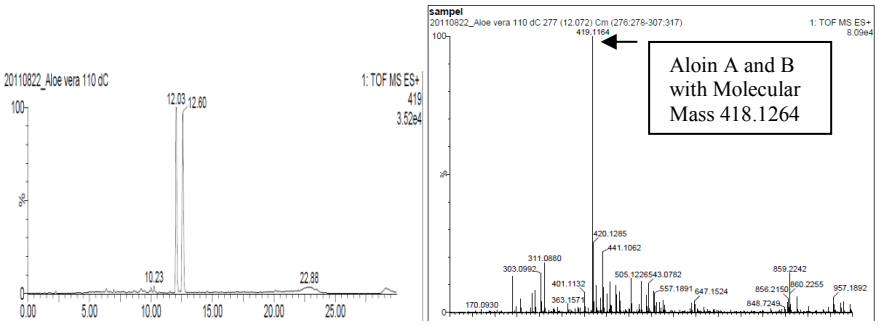


Fig. 3. Extracted Chromatograms and Mass Spectral Data (Aloin A and B) of *Aloe vera*Powder at 110°C Drying Air Inlet Temperature.

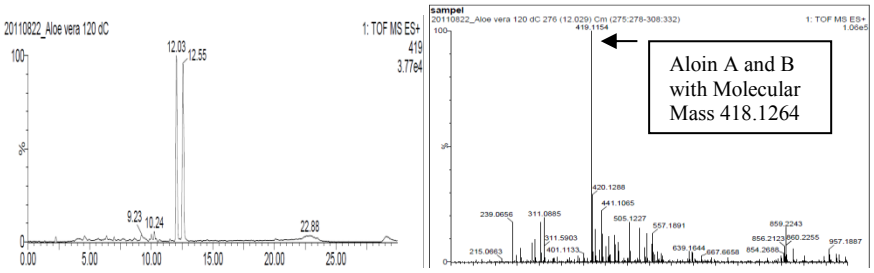


Fig. 4. Extracted Chromatograms and Mass Spectral Data (Aloin A and B) of *Aloe vera* Powder at 120°C Drying Air Inlet Temperature.

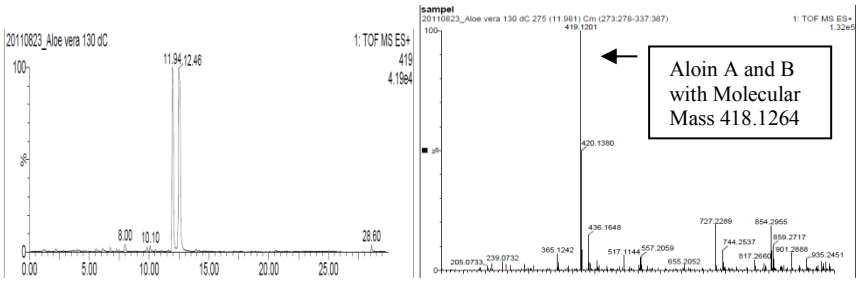


Fig. 5. Extracted Chromatograms and Mass Spectral Data (Aloin A and B) of *Aloe vera*Powder at 130°C Drying Air Inlet Temperature.

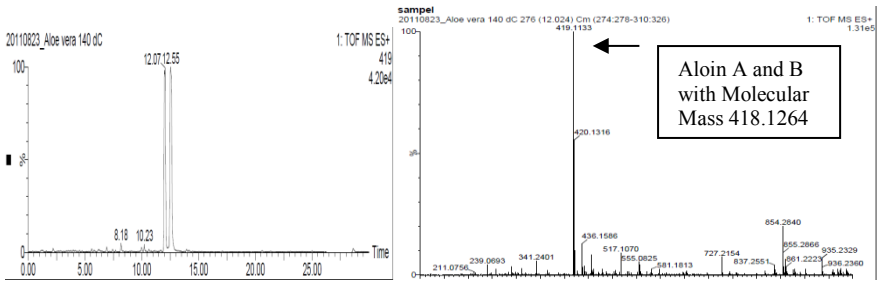


Fig. 6. Extracted Chromatograms and Mass Spectral Data (Aloin A and B) of *Aloe vera* Powder at 140°C Drying Air Inlet Temperature.

The optimum operation condition was obtained after the result of LC-MS achieved so the active components of *Aloevera* powder can be maintained. The optimum drying air inlet temperature was 120^0C, which the active component of *Aloe vera* powder such as *Aloenin (B),Aloeresin A*and *Chrysophanol* was maintained. The LC-MS result was presented in Table 3.

Table 3. The Result of LC-MS Qualitative Analysis of *Aloe vera*Powder.

Sample	Aloin A and B	Aloe-emodin	Aloenin (B)	Aloesin	Aloinoside A and B	Aloeresin A	Chrysophanol
Liquid *Aloe vera*from evaporation process	detected (RT 12.0 and 12.5 minute)	Not detected	detected (RT 21.1 minute)	detected	Very poor*	detected	detected
***Aloe vera* Powder 110°C**	detected (RT 12.0 and 12.5 minute)	Not detected	Low	detected	Very poor*	detected	detected
***Aloe vera* Powder` 120°C**	detected (RT 12.0 and 12.5 minute)	Not detected	Low	detected	Very poor*	detected	detected
***Aloe vera*Powder 130°C**	detected (RT 12.0 and 12.5 minute)	Not detected	Very low	detected	Very poor*	Not detected	Not detected
***Aloe vera* Powder 140°C**	detected (RT 12.0 and 12.5 minute)	Not detected	Very low	detected	Very poor*	Not detected	Not detected

*wavelength was very poor

4. Conclusions

Based on the research done, it can be concluded the following:

- Some of quality parameters such as water content, pH, solubility, colour, appearance, and microbiology are in compliance with the standard of available commercial product.
- The optimal drying inlet temperature was found at 120^0C, which the active compounds of *Aloe vera* powder (aloenin (B), aloeresin A and chrysophanol) can be maintained.

Acknowledgment

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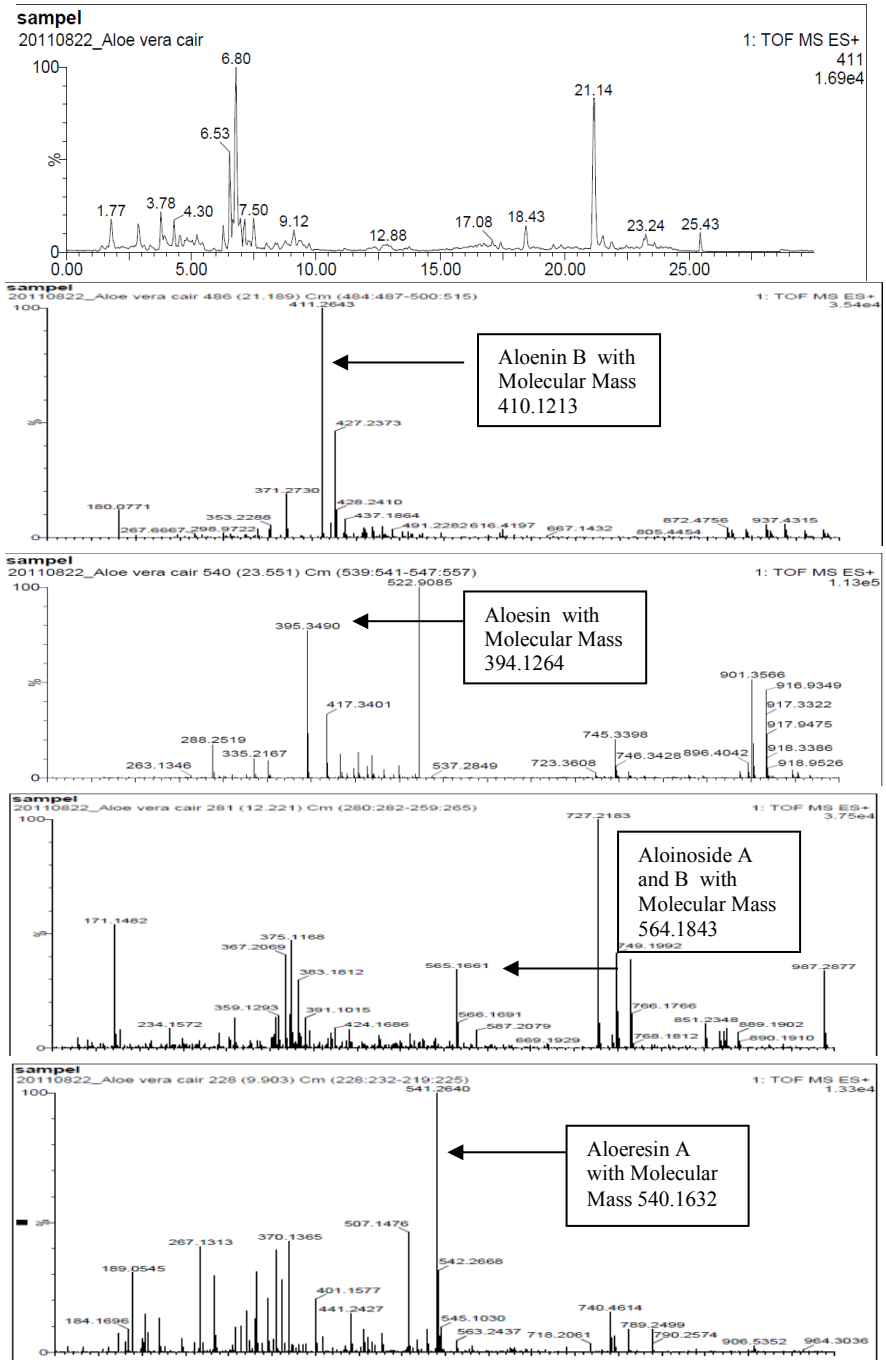
Appendix A

Extracted Chromatograms and Mass Spectral Data of *Aloe vera* Powder



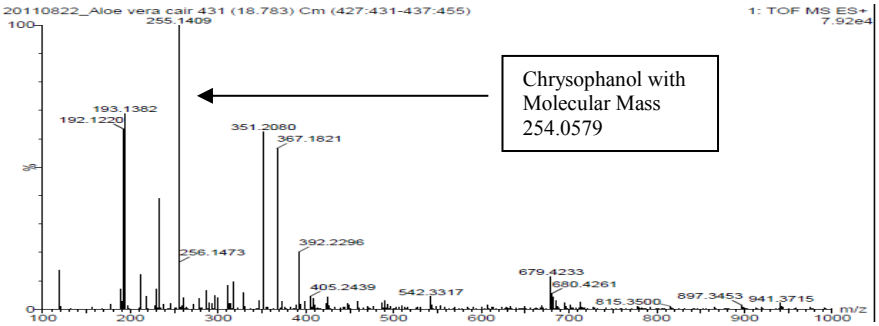
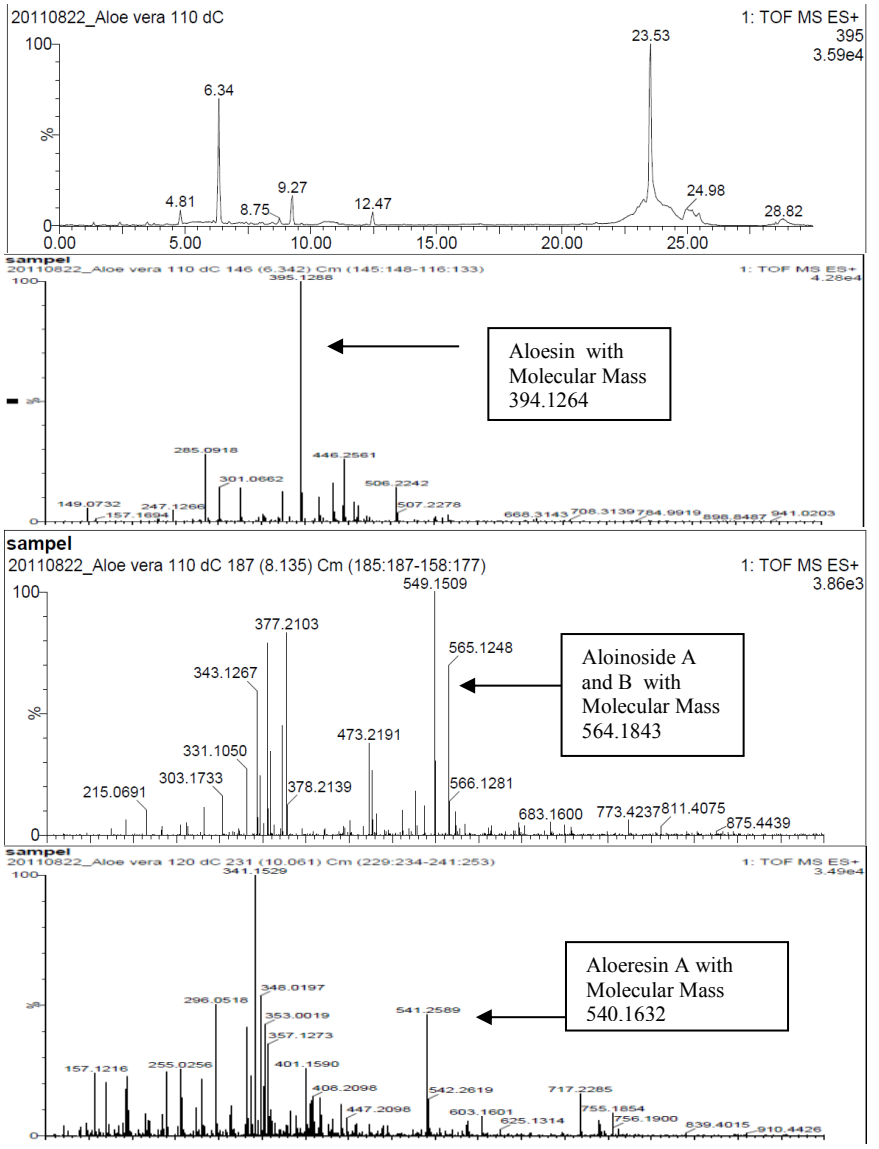


Fig. A-1. Extracted chromatograms and Mass Spectral Data of *Aloe vera* Extract produced from Evaporated.



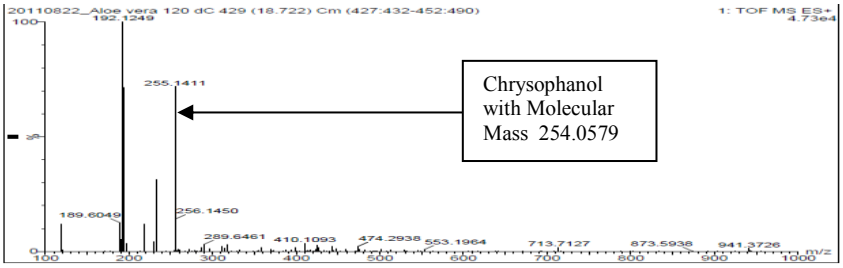


Fig. A-2. Extracted Chromatograms and Mass Spectral Data of *Aloe vera*Powder at 110°C Drying Air Inlet Temperature.

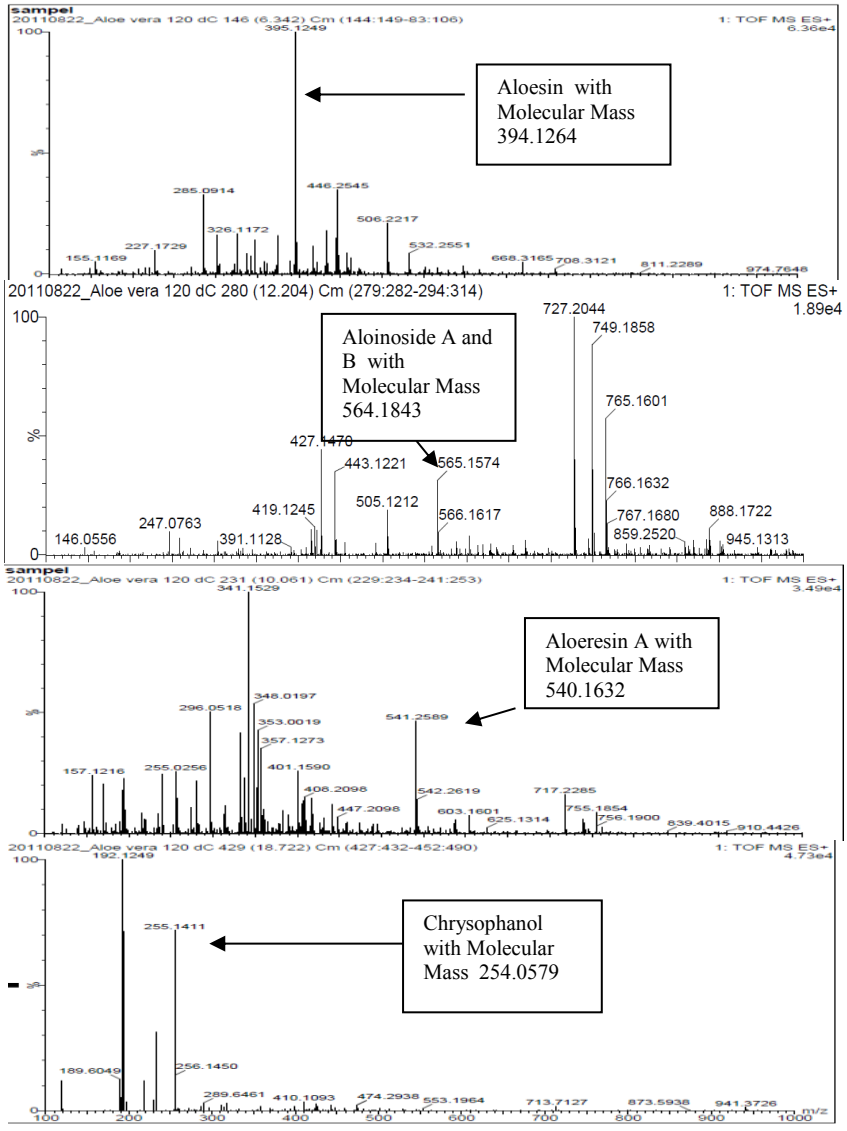


Fig. A-3. Mass Spectral Data of *Aloe vera* Powder at 120°C Drying Air Inlet Temperature.

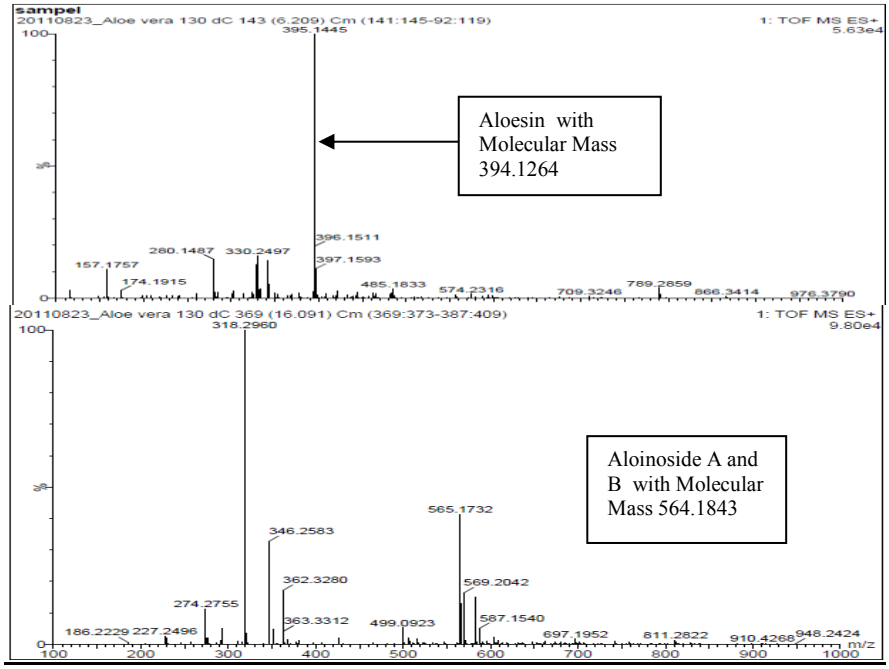


Fig. A-4. Mass Spectral Data of *Aloe* vera Powder at 130°C Drying Air Inlet Temperature.

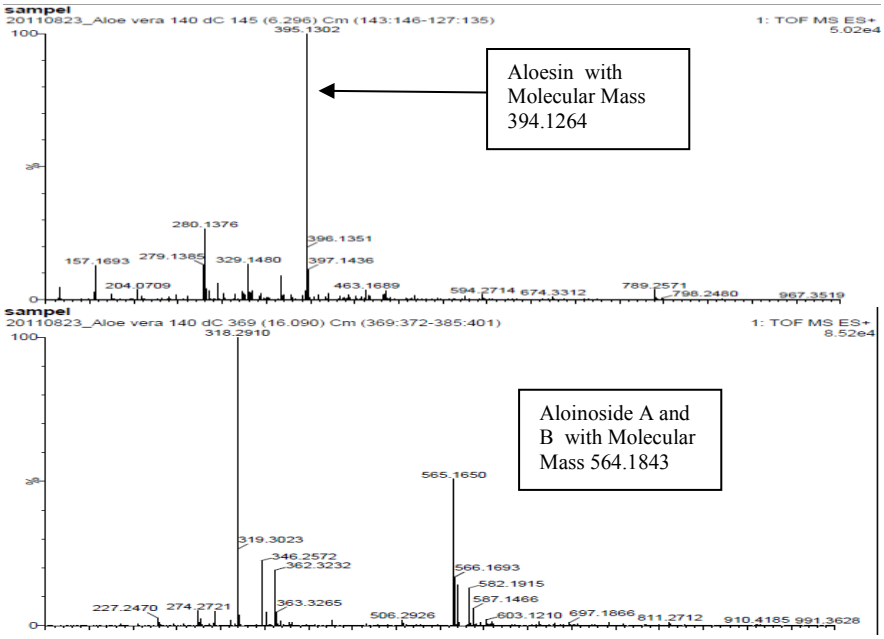


Fig. A-5. Mass Spectral Data of *Aloe vera* Powder at 140°C Drying Air Inlet Temperature.