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Phytochemical and Nutrient Composition of Aloe Vera (*Aloe barbadensis miller*) in an Agro-climatic Condition of Mizoram, India

Dibyajyoti Talukdar[1], Papori Talukdar[2], Athokpam Donin Luwang[1], Kalyan Sarma[1], Dhiren Deka[3], Dhrubajyoti Sharma[3], Biswajit Das[3]

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ABSTRACT

Background: Aloe vera has been used by mankind for thousands of years in folk medicine for its therapeutic properties. The rich phytochemistry of Aloe vera has revealed great potential for improving the performance of livestock and poultry. Mizoram lies in the Indo-Myanmar sub-tropical forest region and is a biodiversity hotspot with many endemic species. The well-heeled biodiversity provides enormous assets and sustainable contribution of medicinal plants and thus leads to frequent use of plants as medicine. Moreover, it was reported that the nutrient composition of the plant depends on the soil quality of the locality. Therefore, the study was carried out to evaluate the phytochemical and nutrient composition of Aloe vera in an agro-climatic condition of Mizoram.

Methods: The physical characteristics of fresh Aloe vera leaf i.e. length, width, thickness, apparent volume, leaf weight, gel weight and percent gel recovery were evaluated by using standard protocols. The nutrient composition of Aloe vera leaf powder *i.e.* moisture, crude protein, ether extract, crude fibre, carbohydrate, total ash, energy level and minerals *i.e.* calcium, phosphorus, zinc, copper, selenium, magnesium and chromium contents were estimated by using standard methods. The extract of each powdered part of Aloe vera plants was used for phytochemical tests and to identify the constituents, standard procedures were carried out.

Result: The physical characteristics of fresh Aloe vera leaf *i.e.* length, width, thickness, apparent volume, leaf weight, gel weight and percent gel recovery were 562.72±6.32 mm, 83.55±4.46 mm, 25.33±4.05 mm, 298.44±7.32 cm^3, 340.28±6.32 g, 180.23±9.39 g, 55.66±1.07%, respectively. The nutrient composition of Aloe vera leaf powder *i.e.* moisture, crude protein, ether extract, crude fibre, carbohydrate, total ash, the energy level was 91.12%, 8.75%, 2.4%, 16.8%, 52.0%,12.5%, 238 kcal, respectively and minerals *i.e.* calcium, phosphorus, zinc, copper, selenium, magnesium and chromium content was 2532.0, 870.1, 41.8, 0.57, 40.1, 8310.0 and 4.5 ppm, respectively. Aqueous and ethanol extraction of Aloe vera confirmed the presence of steroids, alkaloids, glycosides, carbohydrates, tannins and tarpenoid. In conclusion, the physical properties of Aloe vera revealed that the weight of the Aloe vera correlates with the gel portion irrespective of the leaf volume. Apart from therapeutic uses of Aloe vera, it can also use for the synthesis of complex chemical substances.

Key words: Aloe vera, Nutrient composition, Phytochemical.

INTRODUCTION

Aloe vera has been used by mankind for thousands of years in folk medicine for its therapeutic properties. This plant is one of the oldest known and its first documented use by humans dates back to an Egyptian papyrus from 3500BC (Crosswhite and Crosswhite, 1984). Most of the Aloe plants were not toxic, but a few were extremely poisonous. *Aloe barbadensis miller*, Asphodelaceae (Liliaceae) family, is a succulent, pea-green colour perennial, xerophytic plant. It contains many aloe biologically active substances, including minerals, proteins, enzymes, carbohydrates, vitamins, saponins and anthraquinones (Talukdar *et al*., 2021). Acemannan; is an important polysaccharide and potent immune compound present in Aloe vera (Darabighane *et al*., 2012). These compounds have numerous pharmacological benefits, including anti-inflammatory, antiviral, antioxidant immunomodulatory, antidiabetic, antiarthritis, wound-healing, antitumour and antifungal properties (Maan *et al*., 2018). The rich phytochemistry of aloe vera has revealed great potential for improving the performance of livestock and poultry (Nalge *et al*., 2017; Amany *et al*., 2020). There has been a trend towards inclusion of Aloe vera as a feed supplement in the livestock and poultry ration (Yadav *et al*., 2017; Luwang *et al*., 2021). These supplements improve

[1]College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Aizawl-796 014, Mizoram, India.
[2]College of Veterinary Science, Assam Agricultural University, Khanapara-781 022 Assam, India.
[3]Ayurvedic College, Jalukbari, Guwahati-781 014, Assam, India.

Corresponding Author: Dibyajyoti Talukdar, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Aizawl-796 014, Mizoram, India. Email: dibya26@gmail.com

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the immunity, intestinal microflora population and health of the digestive system, which reflects on productive performance.

Mizoram is one of the states of Northeast India and is populated mainly by the Mizo tribe. It is located between 21°56′N to 24°31′N and 92°16′E to 93°26′E. The climate of Mizoram is relatively mild. Mizoram has pleasant weather; never too hot nor too cold during summer and winter. Mizoram slander in the Indo-Myanmar sub-tropical forest region and is a biodiversity hot-spot with numerous endemic species. The well-heeled biodiversity provides enormous assets and sustainable contribution of medicinal plants and thus leads to frequent use of plants as medicine. It has been reported that prospection and research on the medicinal plants that contribute to the health care of Mizo tribes need a more intensified endeavour. Moreover, it was reported that the nutrient composition of the plant depends on the soil quality of the locality (Talukdar *et al*., 2016). Therefore, the present study was carried out to evaluate the phytochemical and nutrient composition of Aloe vera (*Aloe barbadensis miller)* in an agro-climatic condition of Mizoram.

MATERIALS AND METHODS

The fresh, healthy and matured aloe vera leaves were obtained from the College of Veterinary Sciences and Animal Husbandry, Aizawl, Mizoram campus and physical properties of Aloe vera was studied. The plant was taxonomically determined and identified at the herbarium of Dept. of Life Sciences, Manipur University, Manipur. The nutrient composition of Aloe Vera was calculated at the Department of Animal Nutrition, College of Veterinary Science, Khanapara, Guwahati. The phytochemical screening of Aloe vera plant extracts was carried out at Ayurvedic College, Jalukbari, Assam. The whole study was carried out in the year 2021-2022.

The collected aloe vera leaves were washed under running water to take away the foreign materials and dirt sticking to it. The spikes and the thick dark green outer skin (epidermis) were peeled out manually from the thick colourless parenchyma (or gel fillet) using a stainless steel knife. The fillets were cut into 50×30×10 mm slabs with the help of stainless steel cutter and stored in an airtight container, till the experiment was started, to avoid moisture loss and contamination.

Physical properties of aloe vera

Leaf size and shape

The axial dimensions *viz.* length, width and thickness were measured from thirty randomly selected leaves using a metallic scale having a least count of 1 mm which was later used to calculate the volume of the leaf using the formula given by Sabat *et al*. (2018).

Leaf weight and gel recovery

Thirty Aloe leaves were randomly selected and weighed before and after peeling the outer parenchymatous layer. The correlation among the leaf weight and leaf volume, leaf weight and gel recovery as well as leaf volume and gel recovery has to be reported.

Nutrient composition of aloe vera

The moisture content was determined by oven drying at 105°C for 24 h; crude protein (Nitrogen×6.25) by micro Kjeldahl digestion and distillation after acid digestion using a Kjeltec1026 Distilling Unit together with a Tecator 2000 Digestion System (Tecator, Hoganas, Sweden); lipid was determined by extracting the residue with 40-60°C petroleum ether for 7-8 h in a Soxhlet apparatus; crude fibre was estimated as loss in the ignition of dried lipid-free residues after digestion with 1.25% H_2SO_4 and 1.25% NaOH in a Fibre cap 2021/2023 System (Foss Tecator, Sweden); and ash was estimated by ignition at 550°C in a Muffle furnace to steady weight. Nitrogen-free extract (NFE) was computed by taking the sum of values for crude protein, crude lipid, crude fibre and moisture and subtracting this from 100 (Maynard *et al*., 1979).

The samples were analyzed for proximate principles as per standard procedures (AOAC, 1990, 2005). Calcium and phosphorous were estimated according to Talapatra *et al*. (1940). The concentration of zinc (Zn), copper (Cu), selenium (Se), magnesium (Mg) and chromium (Cr) in the samples were determined in an air-acetylene flame on an atomic absorption spectrophotometer (Shimadzu Scientific Instruments, Kyoto, Japan) after digestion in the tri-acid mixture (HNO_3:$HClO_4$:H_2 SO_4 ″3:2:1 ratio).

Phytochemical screening of Aloe vera plant extracts

Aloe vera leaf powder was prepared according to the method described by Saritha *et al*. (2010). The extract of each powdered part of Aloe vera plants was used for phytochemical tests and to identify the constituents, standard procedures were carried out as described by Trease and Evans (1989) and Sofowora (1993). Tannins, carbohydrates, alkaloids, terpenoides, glycosides and steroids were estimated following standard methods (Verma *et al*., 2017).

Thin layer chromatography (TLC)

It was used for the conformation of the different secondary metabolites on analytical plates. The prepared extracts were dissolved in their respective solvents with 1 mg/ml concentration. A 10 µml of the extract was loaded on the analytical plate (2.5cm above from the bottom) and dried on air for thirty minutes. The spotted plates were kept in previously saturated developing chambers containing mobile phase and allowed to run 3/4th of the height of the prepared plates (Stahl, 2005). TLC of ethanol extract was carried-out with Toluene: Ethyl acetate: Methanol: Acetic acid (7:3:1:02) as solvent. The different bands of chromatograms were observed under visible light and photographed. Different spraying reagents were used for the detection of different bioactive compounds like Dragendorffs reagent for alkaloids, Con. HCl for saponins, $CHCl_3$ for glycosides.

The retardation factor (RF) value of separated fractions was calculated as follows:

RF= Distance travelled by spot/distance travelled by solvent front

Statistical analysis

The data were analysed as per methods described by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Physical properties of aloe vera

Aloe vera is a cactus-like plant which has a stem with triangular, fleshy leaves ranging in colour from grey-green to bright green (Fig 1 A and B) and in the margin of the leaves has small white teeth. The leaves were composed of three layers: an inner gel, a yellow sap and the outer thick layer (Fig 1C).

Table 1: Physical parameters of fresh Aloe vera leaf.

Parameters	Value	Range (Sabat *et al.*, 2018)
Length (mm)	562.72±6.32	495-590
Width (mm)	83.55±4.46	66-100
Thickness (mm)	25.33±4.05	18-29
Apparent volume (cm^3)	298.44±7.32	217-353
Leaf weight (g)	340.28±6.32	295-417
Gel weight (g)	180.23±9.39	151-215
Gel recovery (%)	55.66±1.07	51-55

The Physical characteristics of fresh Aloe vera leaf i.e. mean values of leaf length, width, thickness, apparent volume, leaf weight, gel weight and gel recovery are depicted in Table 1. It has been observed that the length of the leaf is about 23-25 times its thickness. A similar result was given by Sabat *et al*. (2018). Sabat *et al*. (2018) reported that the physical properties of fresh Aloe vera leaves were correlated with gel yield and it was found that the leaf weight has a direct effect on the gel yield whereas the effect of leaf volume is found to be minimal.

During analysis, it was also observed that leaf weight, apparent volume and gel yield had some relationship. Hence, the apparent volume could be taken as a parameter for the estimation of fresh weight and gel yield and vice versa. The relationship between apparent volume-fresh weight, leaf weight-gel yield and apparent volume-gel yield of aloe leaves is shown in Fig 2, 3 and 4, respectively. The relationship between the apparent volume and fresh weight of Aloe vera leaf is depicted in Fig 2. The relationship between the weights of aloe vera leaves and gel recovery

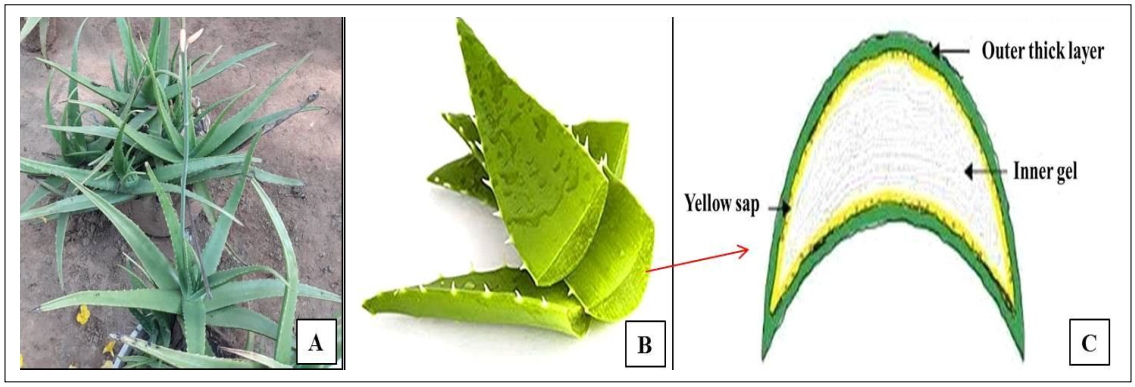

Fig 1: Aloe vera (*Aloe barbadensis miller*). A. Aloe vera plant. B. Aloe vera leave. C. Cross section of Aloe vera leaves.

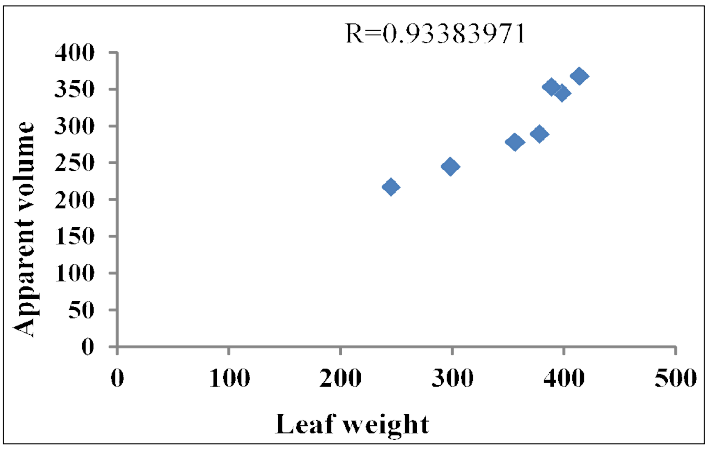

Fig 2: Relationship between apparent volume and fresh weight of Aloe vera leaf.

of Aloe vera leaf is depicted in Fig 3. Fig 4 shows the relationship between apparent leaf volume and gel recovery of Aloe vera leaf.

Nutrient composition of Aloe vera leaf

The proximate analysis (on a dry matter basis) revealed that the leaf pulp of Aloe vera contained 91.12% of moisture, 8.75% of crude protein, 2.4% of ether extract, 16.8% of crude fibre, 52.0% of carbohydrate, 12.5% of total ash and 238kcal of energy.

Mineral estimation of leaf pulp of Aloe vera revealed the highest presence of magnesium (8310.0 ppm) followed by calcium (2532.0 ppm), phosphorus(870.1 ppm), zinc (41.8 ppm), selenium (40.1 ppm), chromium (4.5 ppm) and copper (0.57 ppm).

Amany *et al*. (2020) reported that the leaf pulp of Aloe vera contained 98.5 to 99.5% of water. Gautam and Awasthi (2007) analyzed the nutrient composition and physico-chemical characteristics of Aloe vera (*Aloe barbadensis*) powder at Pantnagar, India and they stated that it contained 18.5% crude fiber, 4.8% crude protein, 2.2% crude fat, 14.0% total ash, 48.0% carbohydrate and 231 kcal energy value. They also stated that Aloe vera contained substantial amounts of iron (64.8 mg/100 g), ascorbic acid (27.0mg/100 g) and β-carotene (335.8 mg/100 g). Dietary fiber was 21.3% while reducing and non-reducing sugars each were 76 mg/10 g. Results of chemical analysis in Faisalabad, Pakistan using whole leaves (on a dry matter basis) also showed that it contains 6.86–15.4% of crude protein, 60.34-72.17% of crude fibre and 14.65-16.88% of ash (Ahmed and Hussain, 2013; Khan *et al*., 2014) which was higher than the present study, might be due to geographical variation as well as soil pattern of the Mizoram.

Analysis of mineral elements is most important to understand the pharmacological and nutritional values of medicinal plants. In the present study, it was found that magnesium, calcium, phosphorus, zinc and selenium were abundantly present in Aloe vera leaves which are essential for metabolism, reproduction, immunological system and growth of connective tissues in the animal (Pawar and Kamble, 2015). Amany *et al*. (2020) stated that the dietary supplementation of Aloe vera (0.1-1.0%) positively increased body weight of poultry by 7-25% and improved immunological indices by 10-50%. They also stated that the feed treatment with 0.5-1% Aloe vera reduced harmful bacteria in the gut by 24% and increased beneficial bacterial

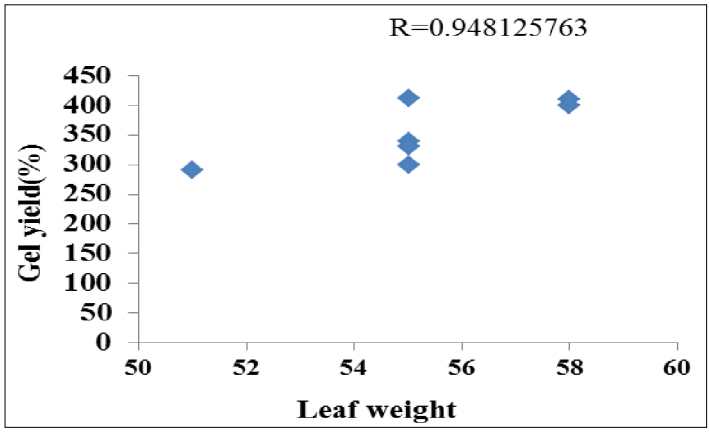

Fig 3: Relationship between weights of Aloe vera leaves and gel recovery of Aloe vera leaf.

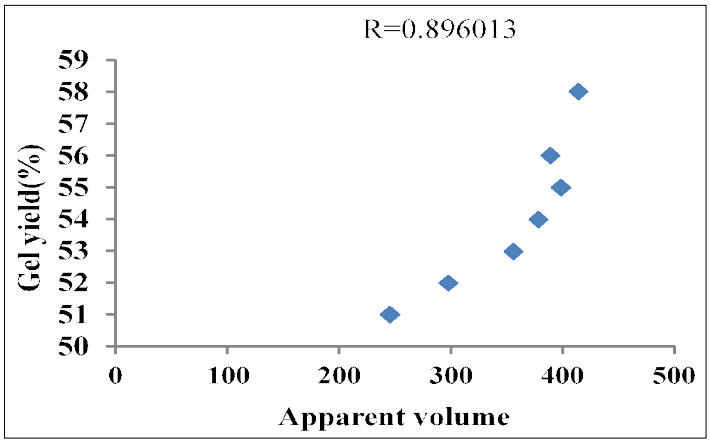

Fig 4: Relationship between apparent leaf volume and gel recovery of Aloe vera leaf.

Table 2: Phytochemical composition of Aloe vera.

Name of test	Observation	
Physical evaluation	Touch	Smooth
	Types of sample	Raw
Pharmacognostic evaluation		
Organoleptic evaluation	Colour	Green
Thin layer chromatography	TLC of ethanol extract was carried-out with Toluene: Ethyl acetate:Methanol:Acetic acid (7:3:1:02) as solvent. Five spots were identified under UV 366 nm andRf values were determined. (0.10, 0.30, 0.40, 0.60, 0.78).	
Phytochemical screening		
Phytochemical screening	Test for steroid	+ve
	Test for alkaloids	+ve
	Test for glycosides	+ve
	Test for carbohydrate	+ve
	Test for tannins	+ve
	Test for tarpenoid	+ve
Phyco-chemical evaluation	Moisture content	2.35%
	Total ash	7.21%
	Acid insoluble ash	1.98%
	Alcohol soluble extractive	45.33%
	Foreign matter	NMT 1%
	Water soluble extractive	36.88%

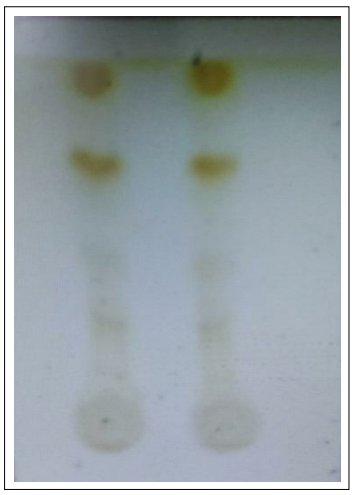

Fig 5: Visualisation of TLC separation of extract of *Aloe barbadensis miller* under white light.

populations by 30%. Due to its functional and therapeutic properties, the use of Aloe vera as a feed ingredient in livestock and poultry rations has increased. Finally, regardless of the technical inconsistencies and differences, levels and types of constituents vary according to geographic location, variety or origin, for that reason, the identification of their active constituents is essential for the best use of the plant (Choi and Chung, 2003).

Phytochemical screening of Aloe vera gel

The results for the phytochemical screening of Aloe vera gel extract using a different solvent in different polarity were represented in Table 2. Aqueous and ethanol extraction methods revealed the presence of steroids, alkaloids, glycosides, carbohydrates, tannins and tarpenoid in Aloe vera. TLC analysis showed five spots R_f (0.10, 0.30, 0.40, 0.60, 0.78) in Toluene: Ethyl acetate: Methanol: Acetic acid (7:3:1:02) solvent system (Fig 5). An ascending chromatography gives an idea about the possible compounds that can be present in the extract from the number of spots. The presence of tannins, saponins, alkaloids, flavonoids and glycosides in Aloe vera was also reported by Mohammed *et al*. (2020). Darshan (2017) reported that Aloe vera contains saponin, alkaloids and flavonoids in methanol extraction. These types of phytochemicals are involved in plant defence mechanisms against various microorganisms with steroids involved in antibacterial properties, flavonoids with anti-oxidant function and tannins are known to be involved in the anti-cancer action (Jannathul *et al*., 2019). All the phenolic compounds are involved in scavenging free radicals with their reducing properties. All these compounds are of pharmaceutical importance as they possess properties such as anti-cancer, anti-diabetic, analgesic, antibacterial and antifungal activity (Jannathul *et al*., 2019).

CONCLUSION

The physical properties of Aloe vera revealed that the weight of the Aloe vera has related to the gel yield irrespective of the leaf volume. Aloe vera is a plant with recognized medicinal significance. As the nutrient composition is a concern, it can be used as a feed supplement in livestock and poultry which can improve the productive and physiological status of the livestock and poultry. As per the report, all the phytochemical present in Aloe vera has

pharmaceutical importance as they possess properties of anti-cancer, anti-diabetic, analgesic, anti-bacterial and antifungal activity. Apart from the therapeutic uses of Aloe vera, it also has great importance in incorporating new sources of phytochemical compounds for the synthesis of complex chemical substances. Further work is necessary to explore its therapeutic and beneficial applications.

Conflict of interest: None.

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