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RESEARCH PAPER

Biochemical Activity, Functional Properties and Texture Profiling of Non-bitter and Bitter Type *Aloe vera* Gel

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Abstract

Aloe vera has long history as a medicinal plant with diverse therapeutic applications and antioxidant properties. Aloe vera contains large number of vitamins, minerals and other biological active compounds. This study was conducted to determine nutrient composition and Functional properties of sweet and bit er type of Aloe vera gel. Gel yield was comparatively more in bit er than non type Aloe vera viz. 521, 422g per kg respectively. The result of the phytochemical screening showed the presence of tannins, saponins, flavonoids and carbohydrate. Ash, fibre, protein and fat content of non bit er and bit er type of Aloe vera gel have slight difference. Bit er type Aloe vera gel shows higher amount of ascorbic acid than non bit er cultivar.Total phenolic content was also higher in bit er type aloe vera gel. Functional group distribution was studied by FTIR spectroscopy. Texture analysis shows that the gel treated with citric acid had maximum firmness.

Keywords: *Aloe vera*, non-bit er and bit er, ascorbic acid, phenols, phytochemical

Aloe vera commonly called Aloe is a cactus like short-stemmed succulent plant with green sharp pointed leaves that are fleshy and spiny containing a clear viscous gel (Joseph and Raj, 2010). The plant is one of the richest sources of health for human beings coming from nature and can be used to treat many ailments both external and internal and comes in tea, gel, juice, salve, and capsule and decoction forms. It is as effective for animals as it is for humans. The plant can be separated into two products: aloe latex and aloe gel. Aloe latex is the bit er yellow exudates. Aloe gel is the colourless gel in the inner part of the fresh leaves (Reynolds and Dweck, 1999). The fresh unpreserved gel contains 99% water. Total solid that remain af er removal of water ranged from 0.8 to 1.5% (Eberendu and McAnalley, 1996; Femenia *et al*., 1999). The major constituent of the solid are fibre, monosacchrides, ash, proteins, fat, and polysaccharides (pectins, cellulose, glucomannan, acemannan and mannose derivatives) and contains mixture of glucosides collectively called 'aloin' which is the active constituent of various drugs (Femenia *et al*., 1999). The exudates of *Aloe vera* are used for numerous medical and cosmetic applications since ancient times (Morton, 1961). Because of medicinal and nutritional properties *Aloe vera* is one of the major industrial crops used in food, pharmaceutical and cosmetic industries (Rodriguez-Gonzalez *et al*., 2012). The phenolic content, antioxidant activity and UV absorbing potential of *Aloe vera* gel have been described as interlinked phenomenon, and phenolic content was found to be critical The use of *Aloe vera*

for product development of enly involve some type of processing such as heating, dehydration and grinding (Di Scala *et al*. 2013). *Aloe vera* products have long been used in health foods for medical and preservative purposes. This is probably due to the *Aloe vera* gel's ability to fine-tune our immunity therefore enhancing the body's abilities to fight off the diseases. Taken together, the objective of the present study was to evaluate the nutritional composition and texture of *Aloe vera* gel.

Materials and Methods

Material

Mature *Aloe vera* leaves were harvested from the Botanical garden of Department of Medicinal and Aromatic Plants, University of Horticulture and Forestry, H.P. The harvested leaves were thoroughly washed with tap water and weighed. The side, base and tip of the leaves were then, removed and the inner portion were cut longitudinally into strips. The gel parenchyma were then cut away from the rind. Gel fillet weight was then recorded. The gel was allowed to dry. The powder of each sample was stored in air tight bag and used for further analysis.

Leaf dimensions and gel firmness

Leaf thickness and width were taken at the base of leaf. Leaf thickness was measured with a vernier calliper and a penetrometer was used to determine the firmness of each leaf gel. The probe was pushed into gel from the middle portion of each leaf. The values recorded were an average of three repetitions and the unit of measurement was pressure.

Gel yield

The gel parenchyma was cut away from the rind with a sharp knife. Gel fillet weights were recorded for each leaf.

Phytochemical Screening

Phytochemical screening for alkaloids, steroids, triterpenoids, glycosides, carbohydrates, flavonoids, tannins, phlobatannins, antiquinones and saponins were carried out qualitatively as per the methods described (Harborne, 1973; Ogbuewu, 2008 and Sofowora, 1993).

Physicochemical Analysis

Moisture, protein, lipid, fiber and ash were determined with standard procedures (AACC, 2000). Total soluble solids (^{o}B) were measured by hand refractometer, whereas, titratable acidity was estimated by titration method using phenolphthalein as an indicator (AOAC, 1990) while pH value of *Aloe vera* gel was determined by the method given by AACC (2000). Ascorbic acid was determined using 2,6-dichloroindophenol titration method (Ranganna, 2009).

The total sugars were determined according to the method of Sadasivam and Manickam (1992). Plant extract was prepared by homogenizing one gram of leaf material in distilled water followed by centrifugation. The supernatant was collected and the residue was again suspended by adding distilled water and centrifuged to complete the extraction and used for total sugars measurement. Estimation of soluble protein content of leaves was done using method given by Lowery *et al*. (1951). Protein estimation was made using standard curve prepared by using BSA.

For total phenol estimation residues were dissolved in 5.0 ml distilled water. 100 µl of this extract was diluted with 3.0 ml water and 0.5 ml of Folin – Ciocalteau reagent was added. 20% Sodium Carbonate was added and the contents were mixed. Af er 60 minute the absorbance of the solution was taken at 650 nm. The results were expressed as mg/g of fresh weight material. Total phenols estimation was made using standard curve prepared by using gallic acid (10-100 µg/ml).

Fourier Transforms Infrared (FTIR) spectrophotometric analysis

The Infra Red Spectra were recorded on FTIR spectrophotometer in KBr and polyethylene pellets. The KBr Pellets contained 2 mg of freeze dried *Aloe vera* sample. Samples were usually scanned in the absorption area of 400 to 4000 cm^{-1}.

Texture analysis

Sample preparation

The *Aloe vera* gel was manually cut into small pieces of small size. The gel was blanched with 3 per cent citric acid, calcium chloride and calcium hydro oxide. The treated samples were analysed for texture profiling.

The textural properties of *Aloe vera* gel samples were measured using Texture Analyzer, TAXT2i (Stable 70 Microsystems, UK), using P/ 75 cylindrical probe. Texture parameters included firmness. Force calibration of the instrument was done prior to start of the experiment to minimize measurement error. The instrument was operated at pre-test speed = 3.073 mm/s, test speed = 2 mm/s, post test speed = 10 mm/s, distance = 20 mm, strain rate = 60%, trigger force = 3 g, force and data acquisition rate of 150 pps.

Results and Discussion

Leaf dimension and gel firmness

Leaf dimension and gel firmness of bit er and non bit er type *Aloe vera* plants are presented in table 1.

Table 1: Comparison of physical parameters of Sweet and Bitter *Aloe vera*

	Non-Bit er	Bit er
Length (cm)	62.73±0.78	47.27±1.48
Width (Middle) (mm)	4.88±0.69	6.89±1.19
Leaf weight (gm)	350.10±16.92	453.82±11.75
Leaf thickness (mm)	7.49±0.15	22.13±0.39
Gel Yield (gm/Kg)	422.00±0.20	550.00±0.29
Peel weight (gm/Kg)	578.00±0.33	450.00±0.28
Firmness (lbs)	6.00±0.01	8.00±0.02
Leaf colour	Dark Green	Green

The mean leaf weight was 453g/Kg for bit er and 350g/Kg , the mean leaf length is more in case of non-bit er type than bit er type. The mean leaf width for bit er type was 6.89 mm and for non-bit er type was 4.88 mm.

Table 2: Qualitative analysis of the Phytochemicals in *Aloe vera*

Constituents	Bit er	Non-Bit er
Tannin	+	+
Phlobatannins	-	-
Saponin	+	+
Flavonoids	+	+
Carbohydrates	+	+
Terpenoids	-	-
Cardiac glycosides	-	-
Anthroquinones	+	+

+ Present, - Absent

Table 3: Comparison of chemical composition of *Aloe vera* gel

Constituents	Non-Bit er	Bit er
Moisture	98.50±0.10	98.98 ±0.20
Fat	0.66±0.03	0.63±0.02
Fibre	0.59±0.02	0.65±0.03
Ash	0.42±0.01	0.45±0.01
Ascorbic acid	4.90±0.10	5.40±0.20
pH	4.50±0.01	4.50±0.01
Acidity	0.049±0.01	0.088±0.02
TSS	1.50±0.01	1.50±0.01

Gels were found relatively firm in bit er type, with mean firmness reading of 8 lbs. The firmness is important, especially for hand filleting, because gel cannot be effectively removed if the leaves are too flaccid.

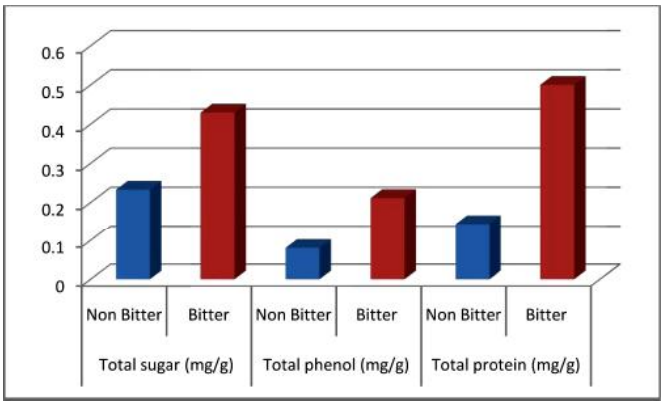

Fig. 1: Different biochemical parameters of Non-bitter and Bitter *Aloe vera*

Phyto-chemical screening

The phytochemical active compounds of *Aloe vera* were qualitatively analysed and results are presented in Table 2. In analysis of tannin, the brownish green colour developed to indicate the presence of tannins. Similarly, based on the colour change which indicates the positive and negative results. Phyto-chemical screening proces was carried out Tannin, saponin, flavonoids, carbohydrates and anthroquinones gave positive results while phlobactanins and steroids gave negative results.

Physicochemical properties

Table 1 shows the mean values and standard deviations of the composition results obtained for the fresh *Aloe vera* gel. Since the moisture content of this product is so high, its other components appear to occur in very small concentrations. In addition, the fresh gel showed >98% moisture content thus, it is susceptible to microbial spoilage as well as enzymatic and oxidation degradation (Miranda *et al*. 2009). Ash content represents the total mineral content and its value in present study was determined as 0.42±0.01, 0.45±0.01 and for non-bit er and bit er type, these values were similar to previous studies reported (Gautam and Awasthi, 2007).

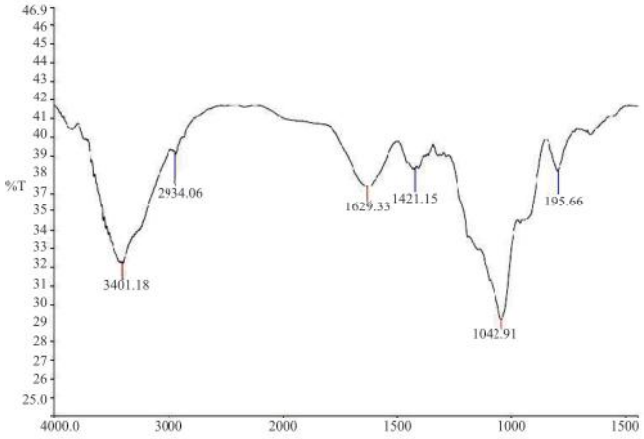

Fig. 2: FTIR Spectra of non bitter type *Aloe vera*

The pH values for both bit er and non bit er type was 4.50±0.01 while titrable acidity (%) value was 0.088±0.02 and 0.049±0.01 % (mallic acid) prospecting. These results were in accordance with previous studies (Vega-Galvez *et al*. 2011) with a pH value of 4.74 ±0.01 and titratable acidity of 0.065 ± 0.01% (malic acid).

The ascorbic acid was reported in dry weight of the analysed plant materials and data are presented in table 1. Ascorbic acid was higher in case of bit er type *Aloe vera* gel with the value 5.40±0.20 than non-bit er type. Presence of important antioxidant ascorbic acid in *Aloe vera* gels was in accordance with the previous studies. Because ascorbic acid is soluble in water, so as an antioxidant it has ability to scavenge aqueous peroxyl redical (Ibe *et al*. 2014).

Biochemical properties

Antioxidents helps to boost the immune system and combat free radicals in the body. The antioxidant inhibitory ability of phenolic compounds has been reported to be due to their hydroxyl groups. Phenol have also been shown to exhibit antidiabetic properties by inhibiting alpha amylase, sodium glucose transporter 1 of the intestinal brush border as well as sucrose (Ibe *et al*. 2014; Oboh and Irondi, 2012). The total phenolic contents were higher in bit er type *Aloe vera* gel (0.212±0.01) on fresh weight basis when compared to non-bit er type of *Aloe vera* gel (Fig. 1). Carbohydrates are widely prevalent in nature. Aloe polysaccharides have medicinal value. In this study total sugar present in *Aloe vera* was determined. Total sugars were higher in bit er type *Aloe vera* gel.

FTIR Spectroscopy

FTIR spectra of freeze dried gel of bit er and non bit er type of *Aloe vera* were basically indistinguishable in the wave number range from 4000-400 cm^{-1} only with subtle differences in the intensity of bands (Fig. 2, 3). Different polar groups such as –OH (correspondence to 3417.58 cm^{-1}), CH_2 correspondence to 2930 cm^{-1}), =C0 (corresponds to 1626.90 cm^{-1}), -COC (corresponds to 1040 cm^{-1}) appeared in the FTIR spectrum of *Aloe vera* gel. The identification of specific compounds and functional group detection also helps in the physicochemical characterization of any material with reference to biochemical and biological activities

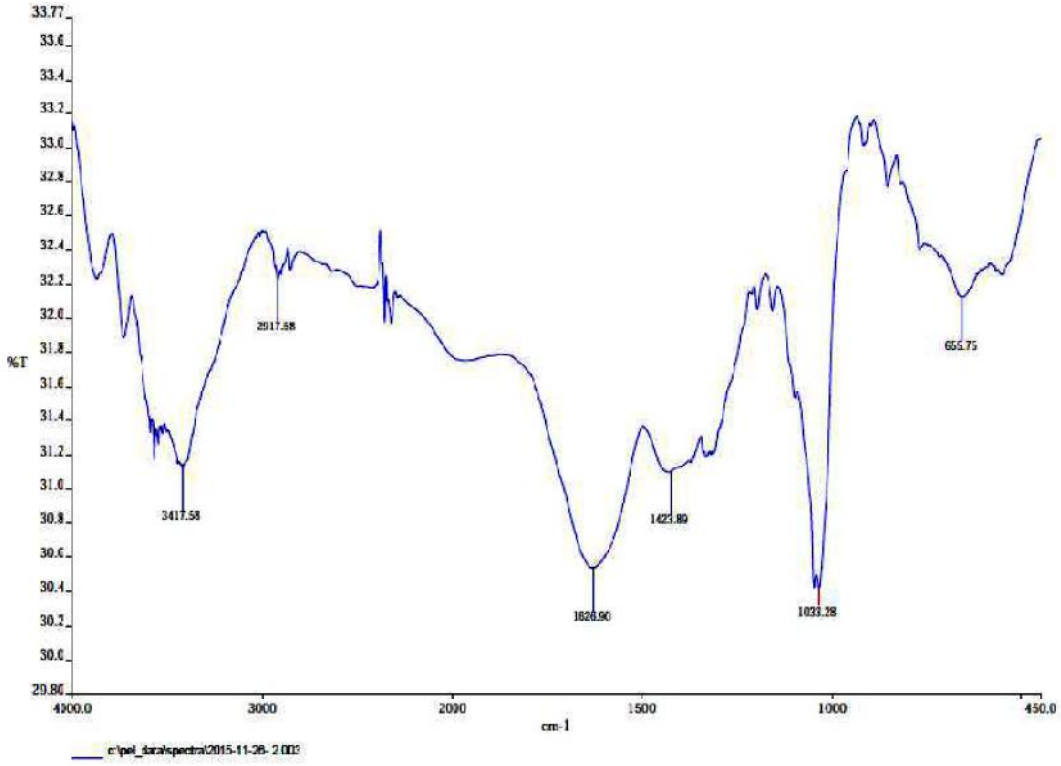

Fig. 3: FTIR Spectra of bitter type Aloe vera

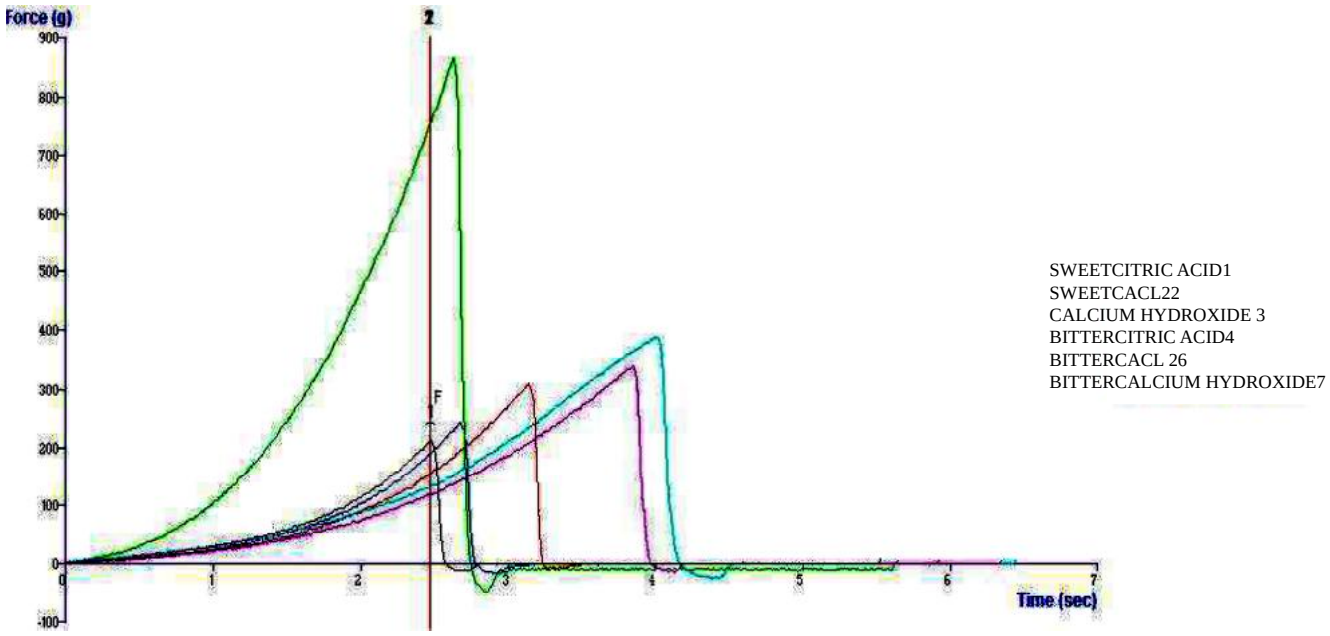

Fig. 4: Texture profiling of Aloe vera gel

(Ray *et al*. 2012). Phenolic –OH stretching frequency appeared with strong and broad intensity of bands at around 3415 cm^{-1}. In bit er type *Aloe vera* gel =C0 stretching at 1626.90 cm^{-1} appeared with strong intensity and broad shaped bands indicating the presence of carbonyl compounds and in non bit er type shows weak absorption.

Texture analysis

Gels of both were treated with citric acid, calcium chloride and calcium hydro-oxide to increase the firmness of gel. Gel in raw form is not very firm and it is difficult to use the gel for the processed products like *Aloe vera* gel preserve, candy etc. For this different type of treatments were applied to increase the firmness. Texture profiling of bit er type Aloe vera gel shows maximum firmness, while non bit er type shows least firmness when treated with citric acid (fig. 4). With all the treatments bit er type had good firmness quality when compared with non-bit er type.

Summary

Aloe vera, a high-value medicinal crop cultivated for its active principles in drug industry, is normally bit er in taste. There exists in nature another type of *Aloe vera* which is non-bit er and mainly used as vegetables in some parts of India. Based on the biochemical and properties, it was concluded that both types contain many nutrients having antioxidant potential but the bit er type, *Aloe vera* has higher amount of ascorbic acid and phenolic contents. Its gel strength was also higher when compared with non-bit er type gel.

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