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Relationship Between Growth Parameters and Aloin Content in *Aloe Vera*

Agriculture

KEYWORDS : Accessions, Aloin, vascular bundles, sheath cells and plant pigments

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ABSTRACT

Aloin is a biologically active molecule synthesized in small sheath cells surrounding the vascular bundles and stored in large paranchymatous cells of Aloe vera leaves which has the laxative and purgative properties. The relationship among growth parameters like leaf length, leaf width and latex colour with aloin content was established in twenty one Aloe vera accessions. The accessions with brown and red colour latex showed the highest aloin content irrespective of its leaf length and width. However, the highest aloin yield per leaf was obtained from the accession named AV17 in which the leaf length and width was the highest and inturn they could posses more number of small sheath cells surrounding the vascular bundles where aloin is synthesized.

Introduction

Aloe vera Linn is an important medicinal plant from Liliaceae family with African origin. It has been confirmed by modern medicine that the plants of Aloe have many kinds of biologically active substances (Reynolds, 1985). Its delicate leaves contain a very small quantity of viscous yellow fluid known as *Aloe* juice or *Aloe* latex, which is embedded in the pericyclic cells of the vascular bundles. The main constituents of latex are anthraquinones including the hydroxyanthracene derivatives, aloins A and B, barbaloin, isobarbaloin and emodin (Bradley, 1992). Bruni and Tosi (1982) observed the distribution of anthraquinones in *Aloe* leaves using fluorescence microscopy. They found that the orange colour globule of anthraquinones only appeared in the chlorenchyma and aquiferous tissues. Aloin, also known as Barbaloin, is a bitter, yellow-brown coloured compound noted in the exudate of *Aloe* species. The Systematic (IUPAC) name of Aloin is (10S)-10-Glucopyranosyl-1,8-dihydroxy-3-(hydroxymethyl)-9(10*H*)-anthracenone. The molecular formula is $C_{21}H_{22}O_9$ (Fig.1) with the molecular weight of 418.39. The percent composition is C 60.28%, H 5.30% and O 34.42%.

Aloin is prepared by drying the latex of and powdered (Fig.2) to make the final product. Once ingested, aloin increases peristaltic contractions in the colon, which induces bowel movements. Aloin also prevents the colon from re-absorbing water from the gastrointestinal tract, which leads to softer stools. This effect is caused by aloin's opening of chloride channels of the colonic membrane. Aloin is used in preparation of laxatives and purgatives.

Fig. 1. Chemical structure of Aloin

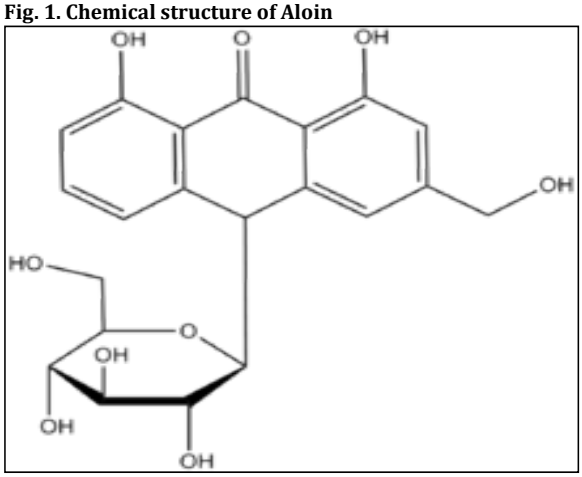


Fig.2. Aloin powder

Inspite of heavy demand for *Aloe vera* in medical and cosmetic industry, its commercial cultivation is not popular among the farming community due to the lack of suitable strains to bring into main stream of cultivation. Hence the study was conducted to find out the effect of the growth parameters like leaf length, leaf width and latex colour on aloin content in different accessions of *Aloe vera* and to suggest the suitable accession for commercial cultivation to meet the *Aloe* needs of medical industry and also to suggest the characters to be considered while selecting the genotype for aloin yield.

Materials and Methods

Experiment was conducted at Faculty of Agriculture, Gandhigram Rural University, Tamilnadu, India during August, 2005 to January, 2007. *Aloe vera* accessions collected across South India were pooled and after purging the identical ones, twenty one accessions were taken for further evaluation in Randomized Block Design (RBD) replicated twice. The accessions were collected from research institutes and wild habitats (Table.1). The accessions were assigned with code numbers from AV_1 to AV_{21}. The suckers collected were planted at a spacing of 75 x 60cm. The fully grown harvestable leaf was collected from four randomly selected and tagged plants in each accession at 240 days after planting and subsequent harvests were made three months after the first harvest. Leaf length and width was measured and expressed in cm. Then the leaves were wiped with a clean cloth and at 2 cm above the base of leaves a transverse cut was given and allowed for half-an hour for the latex to drain form the leaves. The latex was collected in pre-weighed Petridish and the weight difference between the empty petridish and petridish along with latex was considered as latex yield (g) on wet basis. The latex colour was recorded by visual observation. The aloin content of concentrated latex dried to a powder form was estimated by the sequential steps as prescribed by Anon [1998] by measuring the absorbance at 512 nm using methanol as compensation liquid. The percent of hydroxy anthracene derivatives as aloin was calculated from the expression

- A x 19.6/m; Where, A is absorbance at 512 nm and m is weight of materials taken for estimation.

Results and Discussion

From the observations it was found that AV_6 had brown latex and AV_{17} had red latex. The rests were with yellow colour exudate. The wet latex collected per leaf from the twenty one accessions was calculated for four harvests. The highest latex yield of 0.500 g per leaf was obtained form the accession AV_{17} while the accession AV_{16} yielded the lowest latex yield of 0.150 g per leaf. The aloin content estimated from the leaf exudates of 21 accessions revealed the significant difference among the accessions evaluated. The accessions AV_6 and AV_{17} registered the highest aloin content of 11.75 and 11.52 percent (Fig.3) respectively and they were at par. Whereas the lowest aloin content of 6.26 and 7.00 percent respectively was obtained from AV_{16} and AV_7. The grand mean obtained was 8.58 percent (Table.1).

Besides the gel which has great potential in cosmetics and food industry, *Aloe* plants also yields latex which is extracted as liquid, then dried into yellow powder and used as potential laxative. Hence, the latex yield and aloin content are the important traits in determining the suitability of particular type of *Aloe vera* for medical industry. The highest latex yield (0.5g $leaf^{-1}$) in AV_{17} could be due to more leaf width (10.92cm) and length (63.1cm) and thereby more number of pericyclic cells or bundle sheath cells in the vascular bundles (Ganesh and Alagukannan, 2009). Shen et al., (2001) proved with histochemsitry and photochemical analyses that the small sheath cells surrounding the vascular bundles might be the synthesis location of barbaloin, and the large parenchymatous cells in the vascular bundles were its storage location. At the centre of vascular bundles, there were xylem and phloem.

It is evident from the data that the aloin content was the highest in accessions AV_6 (11.75 %) and AV_{17} (11.52 %) where the colour of latex was brown in AV_6 and red in AV_{17}. Bhavsar *et al.*, (1990) also reported the aloin content range of 2.52 to 13.39 percent. The present study also confirms the earlier findings regarding aloin content. Though the leaves of AV_6 are small with the leaf length of 45.19cm and leaf width of 4.40cm, its aloin content was the highest and this finding confirms to the results of Srivastava *et al.*(1990).

The results of the study clearly brought out the fact that there is no relationship between leaf length and leaf width with the aloin content as the two accessions viz., AV_6 and AV_{17} were at par with its aloin content but those two accessions were in two different extremes while concerning leaf length and leaf width. In other words the accession with biggest leaf and smallest leaves were at par as far as aloin content is concerned. The colour of the latex influences the aloin content in *Aloe vera* accessions. The other accessions with yellow colour latex expressed the aloin content of 6.26 to 10.25 per cent. From the study existence of complex relationship between plant pigments like xanthophylls, anthocyanins, carotenoids and aloin is noticed and it has to be further explored to describe the exact relationship. But the non-existence of relationship between growth parameters like leaf length and leaf width on aloin content is well established. However, as AV_{17} yielded more quantity of latex (0.500g $leaf^{-1}$) the aloin yield per leaf (0.058g) was also the highest, whereas the aloin yield per leaf (0.032g) was the lowest in AV_6 as it yielded 0.274 g of wet latex/ leaf. The highest latex yield/leaf is attributed to the more number of sheath cells surrounding the vascular bundles of AV_{17} as the aloin is synthesized in sheath cells and stored at large parenchymatous cells in the vascular bundles. This finding is in consonance with the findings of Yuan et al., (2003) as they stated that the developmental degree of large parenchymatous cells of vascular bundles, the vascular bundle sheath and aquiferous tissue sheath may have a positive correlation with aloin content.

Conclusion

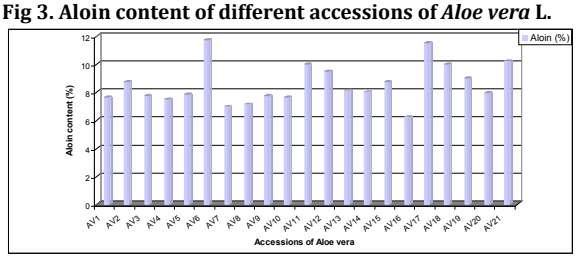
Aloin is one kind of anthraglycosides, and a physiologically active component in *Aloe* leaf. So it is important to determine the highest aloin yielding accessions for commercial cultivation to meet the demand of medical industry. From the study it was concluded that the accessions with more leaf length and width possessing red colour latex yielded more aloin. Due consideration should be given for leaf length, leaf width and latex colour while selecting the genotypes for aloin yield and while framing the breeding strategy on *Aloe vera*.

Table 1. Relationship between growth parameters and aloin content and yield in different *Aloe vera* accessions

Code number of the accession	Origin	Leaf length (cm)	Leaf width (cm)	Latex colour	Wet latex yield $leaf^{-1}$ (g)	Aloin content (%)	Aloin yield (g $leaf^{-1}$)
AV_1	Indian Institute of Horticultural Research (IIHR), Bangalore	48.96	6.79	Yellow	0.325	7.63	0.025
AV_2	-do-	49.24	6.04	Yellow	0.254	8.75	0.022
AV_3	-do-	47.85	7.08	Yellow	0.299	7.75	0.023
AV_4	-do-	51.58	7.81	Yellow	0.285	7.50	0.021
AV_5	-do-	50.32	6.16	Yellow	0.331	7.85	0.026
AV_6	-do-	45.19	4.40	Brown	0.274	11.75	0.032
AV_7	Gandhigram, Tamilnadu	51.17	6.78	Yellow	0.283	7.00	0.020
AV_8	Oddanchatram	45.78	7.54	Yellow	0.334	7.15	0.024
AV_9	Salem	48.96	7.90	Yellow	0.379	7.75	0.029
AV_{10}	Karur	48.16	7.78	Yellow	0.349	7.63	0.027
AV_{11}	Kollihills	44.34	5.62	Yellow	0.251	10.00	0.025
AV_{12}	Virudhunagar	43.59	5.40	Yellow	0.344	9.50	0.033
AV_{13}	Erode	49.70	6.03	Yellow	0.314	8.15	0.026
AV_{14}	Coimbatore	50.06	7.02	Yellow	0.384	8.04	0.031
AV_{15}	Hosur	47.66	7.33	Yellow	0.290	8.75	0.025
AV_{16}	Tiruvannamalai	59.17	10.11	Yellow	0.150	6.26	0.009
AV_{17}	Trichy	63.10	10.92	Red	0.500	11.52	0.058
AV_{18}	JIPMER, Pondicherry	40.89	6.96	Yellow	0.244	10.0	0.024
AV_{19}	PAJANCOA, Karaikal	46.42	7.19	Yellow	0.334	9.00	0.030
AV_{20}	Kalkada – Andrapradesh	48.81	7.05	Yellow	0.309	7.95	0.025

AV_{21}	Vellanikara - Kerala	49.53	7.31	Yellow	0.280	10.25	0.029
-	Grand mean	49.07	7.10	-	0.309	8.58	0.027
-	SEd	4.66	0.71	-	0.006	0.37	0.001
-	CD (0.05%)	9.72	1.48	-	0.013	0.77	0.020

Fig 3. Aloin content of different accessions of *Aloe vera* L.



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