

PHARMACOGNOSY

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INTRODUCTION

"Aloe gel, the new wonder anti-ageing agent." "Aloes, the new breakthrough in skin treatment". These are typical of certain claims being made concerning the benefits derived from the use of Aloe and Aloe extracts. Obvious questions arise out of statements such as the above, e.g. is there any documented scientific or experimental evidence that could justify such statements, and if in fact Aloe products do "work" how and why do they work?

Organic Aloe Africa (O.A.A.), as a South African company producing Aloe products has initiated an ongoing literature study of the subject as well as a programme of experimental research in order to answer the above questions.

ALOES: A TIMELESS FAD?

The remarkable growth in popularity of ALOE GEL amongst first world populations during the past 10 to 20 years has been accompanied by world-wide promotional campaigns. This has raised the question: Whether Aloe in cosmetics is another passing fashion? In the past there have been vogues for asses' milk, queen bee jelly, various herbal and other natural products such as whale oil; more recently synthetic products and tissue extracts such as collagen and foetal products have had or are having their vogue. This question is easily answered in the negative. To be in fashion implies short duration and perhaps also limitation to societies with the means to pursue non-essential fancies. In contrast to this, aloes have been used continuously for many centuries and by people not concerned with triviality. Newspaper and magazine advertising, radio, cinema and television publicity came much later. Aloes were spread to the New World by unsophisticated mariners who carried it aboard ships as treatment for skin injured by salt, rough ropes and canvas, and exposure to the elements. Missionaries spread aloes along with their faith among primitive communities. African slaves took aloes as personal possessions with them into an unknown future. In many places aloes were adopted and grown by communities not exposed to advertising campaigns or sales promotion.

In a much earlier era, the Old World had tried and tested aloes. Today it is not clear to what extent bitter sap or crystals and gel were used either as a natural mixture or as separated components. The Arabs certainly knew the use of the bitter crystals - the name Aloe and the laxative ingredient aloin is said to be derived from an Arab term for a shining substance. According to carvings on the pyramids aloe had a place in the practice of hygiene and religion of ancient Egypt. Prominent Greek and Roman physicians prescribed aloes and left detailed records of their high opinion of its value in medical practice. Taken eastwards by Arab traders,

aloes were grown and used medicinally as far away as China, even in the time of Marco Polo.

To be purely fashionable also implies that a custom is transferred directly by observation or communication between established adherents and those to be converted. In this regard it is interesting that isolated societies as far removed as the indigenous peoples of South Africa, had independently discovered the use of aloes. Human ringworm was traditionally treated by the Xhosa with the pulped leaves of *A saponaria*, and for internal worms they use a decoction of *A tenulor* root while the Zulu administer extract of *A marlothii* by mouth for round-worms. It was common practice to apply the cut surface of aloe leaves to fresh skin wounds as well as to infected ulcers and boils: among examples of the practice is the use of *A fosteri* leaves warmed in hot ash, cut and placed on wounds and sores by the Bakone, while the Cape Coloureds used *A variegata* in this fashion for gumboils and infected teeth. Cosmetically the Pondo people use the juice of *A aristata* mixed with water to wash their bodies for its tonic and refreshing effect.

There are many more reports of the use of South African aloes by different ethnic groups. Interesting pictorial evidence of this is the presence of *A ferox* in a centuries-old rock painting preserved in a cave. The San (or Bushmen) were not caricaturists; they depicted those animals and other phenomena, natural or mystic, that were important in their daily lives.

BOTANY

Approximately 348 separate species of the genus Aloe have been described scientifically to date: however, fieldwork is continuing and some hitherto unpublished species have been recognised. Classification and taxonomy (the allocation of botanically correct names to separate species) of this genus is continually under expert review. This includes ongoing study of earlier descriptions on which much of the taxonomy is based.

All Aloes are indigenous to the African continent (283 species) and the closely adjacent geographical regions: Yemenite Arabia (17 species) and the islands Madagascar (46 species) and Socotra (3 species). Many species grow readily when transplanted to a suitable habitat and have established themselves as naturally growing populations in the wild on foreign continents.

Aloes grow in a wide variety of environments: deserts and moist places, at sea-level and on high mountains, in the tropics and in cool moderate climates. Understandably species with a wide range of forms have developed, ranging from many metres tall to a height of a few centimeters; some with stout leaves and others grass-like leaves; many have stems while others do not; there is also variation in external

characteristics such as the size and number of thorns. There is, however, a common basic structure: all Aloe species have a rosette of leaves which are more or less succulent and from which the inflorescence (flower-bearing structure) arises as one or more spikes.

The unusual hardness of many Aloe species is perhaps relevant considering the attributes of Aloe derivatives in skin care. Firstly, there is the ability of living Aloe plants to withstand drying out. This is well exemplified by an indigenous South African species, *Aloe variegata*. The folk name of this plant is "Kanniedood", which means "cannot die". This plant was included by 16th and 17th Century European botanists in a small group of South African Aloes under the Latin name "semper vivum", which may be translated as "live forever". Specimens of these Aloes may be placed on a shelf or suspended in the air without water or feeding, where it will flower at the right season for two successive years. Taking into account the considerable energy required for any plant to produce flowers, this is an almost unbelievable performance which testifies to the

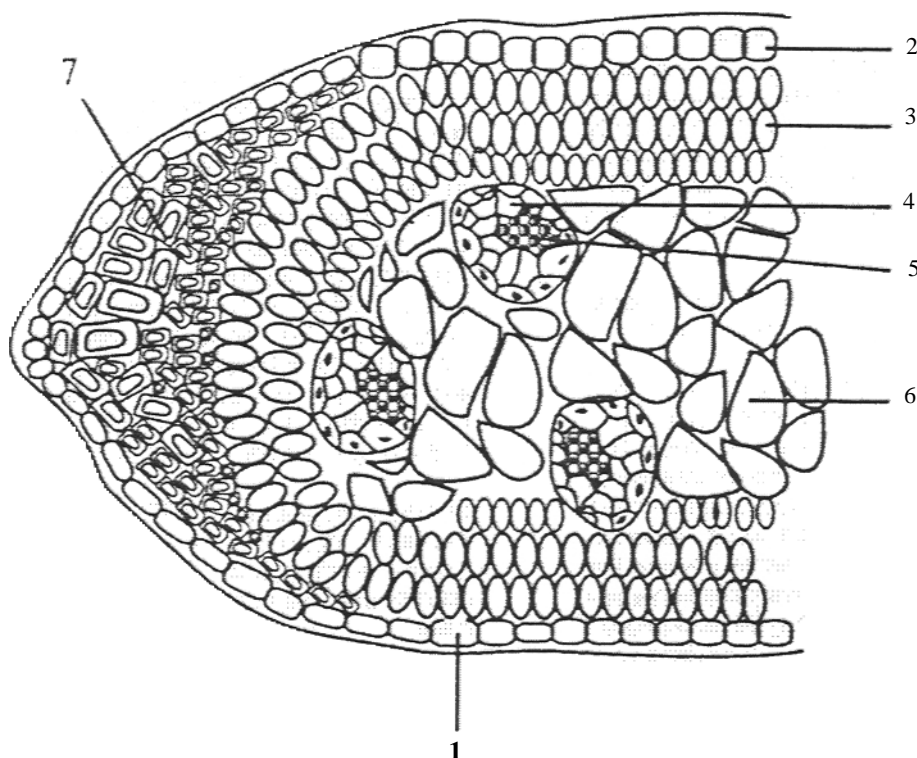
ability of some Aloe species to retain moisture and conserve their metabolic resources. Inherent properties of Aloe gel must be responsible for this remarkable protection against desiccation.

In naturally-occurring mixed plant communities in many parts of Southern Africa, Aloes have been observed to be comparatively better protected against predation by plant-eating animals as well as less susceptible to attack by bacteria and fungi. This may be due to protection conferred by the bitter sap in the outer peel, combined with the antibiotic property of certain gel constituents.

MORPHOLOGY AND HISTOLOGY

When Aloe leaves are cut through their width there is again a basic structure. On the outside is a peel (also referred to as skin or epidermis), usually green or grey, sometimes reddish-brown, in colour. In or underneath this external layer are specialised peri-cyclic cells, shaped like narrow

TRANSVERSE SECTION OF AN ALOE LEAF



1. Stomata
2. Epidermis
3. Palisade cells
4. Endodermis

5. Pericyclic cells in which the aloetic juice is contained
6. Mucilage-containing cells
7. Sclerenchyma

canals, from which a yellow to brown sap flows when cut. This sap is the commercial source of the "Bitter Aloes" or "Crystal Aloes". This product, obtained by concentrating and drying the sap, has been used since ancient times, mainly as a purgative, a suppressant of intestinal parasites in medicine and veterinary science, and for the treatment of many other conditions. Its most active principle is aloin, a complex chemical compound, but depending on the species of Aloe, the crystals contain a variety of other related constituents as well as complex resins.

In general, the inner portion of Aloe leaves are more or less fleshy or jelly-like. It consists of mucinous material, of which a very large proportion is water (more than 99% in some species), supported by a delicate matrix of fibres. Liquid expressed from this inner part of the leaf, commonly referred to as liquid Aloe gel, contains a large variety of chemical substances: simple sugars as well as complex carbohydrate compounds, protein, amino-acids, lipids and oils, minerals, various organic acids, as well as biologically active substances such as vitamins, enzymes and antibiotics. The presence as well as the concentration of these different constituents in the leaf depends on numerous variables:- the species, the location, the climatic conditions, etc.

NOMENCLATURE

The term ALOE VERA has regrettably become, in addition to having a very specific, scientific and botanic sense, a confusing trade name. Even in the case of the plants in the aloe plantations which were artificially established in the West Indies and Americas subsequent to the arrival of the Spaniards, there is a confusion in the promotional pseudo-scientific literature, where the names ALOE VERA and ALOE BARBADENSIS compete with one another .

In the late 18th Century the Swedish botanist, Linnaeus, laid the basis for the present system of exact botanic names. For any plant there is first the name of the genus (common name for a group of closely-related plants) always commencing with a capital letter. In this instance it is written: Aloe. This is followed when dealing with an individual species by the species' name, written without a capital letter. Thus we have: Aloe vera, Aloe ferox, Aloe arborescens and so forth. In any written record the genus is spelled out in full on the first occasion when the name is used; thereafter it may be abbreviated to the commencing capital letter, thus: A ferox, A vera. When the scientifically accepted binomial (meaning two named) terminology is used in scientific reports, it is common to print the name in italics or to underline it: *A ferox*, *A vera*, etc. A second invariable, but sometimes unfortunate rule of Linnean taxonomy is that the binomial name which was first published for a given species, must be retained.

On occasion a very suitable name currently in use has to make way for one less descriptive *or* appropriate, because it had been published earlier .

The process of bringing order into botanic taxonomy is time-consuming and on-going, involving as it does, many old manuscripts. This applies particularly to the genus Aloe and others resembling it, probably because these hardy plants were more easily transported and thus cultivated comparatively early in 16th and 17th Century Europe, and so came to the notice of pre-Linnean botanists dealing with plants far from their place of origin

The name Aloe vera was first published by a Dutch botanist, Burmann, who was describing the distinct or separate species now recognised by this name, between 1st March and 6 April 1768. His report was based on specimens cultivated in Holland from plants brought from India. Much botanic confusion with regard to the use of this name for a distinct species arose because Linnaeus had earlier (1753) used the term vera as a sub-species name in Aloe perfoliata variety vera. It was subsequently shown that perfoliata was botanically invalid as a specie's name because it included several separate species, of which some did not even belong to the subsequently defined genus Aloe. When the name perfoliata and its several varieties (which had included the Cape Aloe under the name A perfoliata variety ferox) fell away, vera became available as a new name and was thus used by Burmann for a separate species.

The difficult history of botanic naming is further illustrated by the now extinct name A barbadensis. The British botanist, Miller, published this species name on 16th April, 1768 for a plant growing in the Chelsea Physic Garden, London. These plants were presumably brought there from the island of Barbados. Much later it was recognised that the plants described by Burmann from Holland and by Miller from London, were of the same species, and thus the name A vera only is retained. Had Miller's publication appeared a few weeks earlier, the name A. barbadensis would have been in use today. This would regrettably have implied that the species had originated in Barbados.

Some seven years later (1775) the Danish botanist, Forsskal, described two species of Aloe from Yemen: A maculata, with yellow flowers, and A officinalis, with red flowers. Both these names have since fallen away because these are recognised today as two flower forms of A vera, with its original habitat now known to be Yemenite Arabia. Interestingly, the yellow flowered form was predominant in the spread to the Mediterranean, including Spain, and from there to the New World, including Barbados. The red flowered form predominated among A vera distributed by traders from Arabia to India, the Far East and East Africa.

It has been suggested on historic evidence that the term "vera" was first applied to an aloe when a plant cultivated in Alexandria (North Africa) was recognised botanically to be the same as plants growing naturally in Yemen, as a general comment in the sense that 'this is truly the Arabian plant'.

Popular ALOE VERA promotional literature has highlighted the historic occasion when Alexander the Great invaded the East African island of Socotra to obtain Aloes for the treatment of his wounded and ailing army. *A. vera* did not grow naturally on this island. Among the three species which do so, *A. perryi* has medicinal and cosmetic properties. Since historic times it has been commonly known as the Socotrine Aloe. This name also caused confusion among earlier botanists. One of the many Aloe species indigenous to the Cape was named *A. Succitrina*, because of its copious gel (i.e. succulent) and abundant yellow juice (reminiscent of citrus). It required research by several botanists over many years before Socotrine Aloes and *Aloe succitrina* were correctly put in their respective botanic and geographic places.

In conclusion, ALOE VERA as a generally inclusive trade term incorporates on historic grounds at least the three botanically separate species: *A. vera*, *A. perryi*, (*Socotrine Aloe*) and *A. ferox* (*Cape Aloe*).

CHEMICAL COMPOSITION OF ALOE

GEL

On what basis may the remarkable and diverse properties which are claimed for Aloe gel and its derivatives be explained? The explanation may lie in its complex chemistry.

1. CARBOHYDRATES

In quantitative terms (water excluded), the largest component of aloe leaves is carbohydrate: some simple sugars but mainly complex polymers in forms variously referred to as pectins, mucopolysaccharides, glycoproteins, glucomannans and so on. These complexes are known in the plant world for their remarkable property of holding moisture and presumably convey to processed aloe gels the desirable moisturising properties when applied to skin surfaces.

Earlier chemical analysis of Aloe-derived glycoproteins revealed compounds built up mainly from glucose and mannose in linear form, partly are tylated (*A. plicatilis*, one of the Cape species, as reported by Paulsen and co-authors: 1978), or in compound linear form (*A. vera*, Gowda and co-authors: 1978). Subsequent analysis of *A. vera* demonstrated four separate glucomannans, of which only one had a jelly-like property (Yagi: 1985). Yagi also described *A. arborescens* as having glycoproteins containing:

(i) linear linked glucopyranose; (ii) branched arabinogalactans; (iii) linear manno-pyranose; and (iv) a glycoprotein with 57% protein and 34% carbohydrate, including glucose and mannose. Only the two components (iii) and (iv) stimulated the function of inflammatory cells.

Early results of a very recent study of the carbohydrates of *A. ferox*, undertaken at the University of Cape Town by Professor A. N. Stephen and Dr. W. T. Masubela and sponsored by the Council of Scientific and Industrial Research, show the presence of numerous sugars including components in the form of pectins, pectic substances, arabinogalactans, hemicelluloses including glucomannoglycans, which have an interesting distribution mainly in the leaf rind as well as the internal fillet. This research on *A. ferox* is continuing, one paper having been submitted for publication.

2. AMINO ACIDS - PROTEINS

Skin building or regeneration will require the presence of the building blocks of all proteins, i.e. amino-acids. *A. vera* was earlier reported (Waller and others: 1978) to possess 17 different amino-acids. Subsequently extracts from *A. ferox* and *A. vera* plants growing side by side in Kirstenbosch Botanic Garden, Cape Town (Van Schalkwyk: 1987; unpublished) were compared. Using an amino-acid analyser, 34 and 37 different amino-acids respectively, were traced, *A. ferox* had almost double the total concentration of amino-acid as *A. vera* (30,1 and 19,2 nMol per mg respectively). Further studies demonstrated that as a result of modern methods of processing, not all the amino-acids were lost. Some were fortunately retained, their concentration having been reduced. Fortunately, among those retained are lysine and hydroxyproline, important tissue-builders in skin and collagen.

3. MINERALS

Minerals are important trace elements in all biology, helping to regulate, among other functions, fluid transfer and balance between living cells. Aloe extracts have been shown to contain calcium, sodium, potassium, manganese, magnesium and iron in the form of several salts, including chloride and phosphate. At present the mineral content of *A. ferox* in its natural as well as processed forms are being studied, an abundance of calcium and iron is evident.

4. ENZYMES AND ANTIBIOTICS

Biologically active constituents are undoubtedly essential to the well-being of the living plant, as well as to human skin. Experience suggests very clearly that these properties may be temporarily transferred by very

fresh aloe material to human and animal skin. The cut surface of a leaf freshly removed from a healthy plant, can achieve quite remarkable results by relieving irritation and in promoting healing. In all honesty it has to be admitted that with present production processes and formulation methods, these properties are not retained, at best they remain present for brief periods and at low concentrations.

5. LIPIDS

Lipids and vegetable oils are valuable in skin care; a variety have already been found in aloes, including cholesterol, lupeol and siterol.

6. ACIDS

Acid balance on skin and hair surfaces are of crucial importance in maintaining health and tone. Mild but stable acids ensure optimal conditions. Among suitable acids found naturally in aloe extracts are lactic acid. as well as ascorbic, malic, succinic and caumaric acids. In mammalian physiology, hyaluronic and glucuronic acids are important in maintaining flow of fluids between tissue cells. Traces of these acids are demonstrable in fresh aloe juice.

DOCUMENTED EVIDENCE SUPPORTING THE CLAIMS OF THE BENEFICIAL USE OF ALOES

The following is an extract from the large body of documented scientific evidence supporting claims of the beneficial use of aloes and aloe derivatives. It is intended to give the reader some idea of the research already done and the scientific proof of the qualities which aloes have.

1949: C J A Lowenthal;

Reported that the surface application of split *A. arborescens* leaf was "a valuable method of treatment of X- Ray burns; all wounds healed well and far more promptly than one could expect from any other form of treatment". He was apparently unaware that it was the same species which had been used in Japan in 1945 for a similar application i.e. the treatment of nuclear burns with great success. (South Africa).

1964: M Soeda et al;

Reported the therapeutic effects of Cape Aloe extracts on low white blood cell counts resulting from X-radiation; and in effectively treating the skin parasite trichophytiasis.

1966: M Soeda et at;

A. ferox was found to have an anti-bacterial as well as anti-fungal effect and was successful in the treatment of burns. (Japan).

1969: M Soeda;

A. ferox showed an inhibitory effect against cancer cells. (Japan).

1971: M C Baruzzi et al;

Reported that the gel of fresh Aloe vera leaves in cosmetic creams in concentrations of 20 per cent improved the characteristics of ageing skin by improving hydration and giving 'restorative' effects. (Italy)

1977: H Ando et al;

Produced evidence suggesting that aloe preparations prepared by 'cold' preservation processes i.e. freeze drying contain a tyrosinase which, with continued application, can inhibit the formation of melanin which is responsible for 'liver' or ageing spots. (Japan).

1977: O S Stepanova et al;

Independently confirmed stimulation by extracts of Cape Aloe of anti-inflammatory human white blood cells as reported by Soeda et al. (Russia).

1978: K Fujita;

Confirmed the anti-fungal effect of Cape Aloe observed by Soeda et al. (Japan).

1979: K Fujita et al;

Demonstrated a clear anti-inflammatory effect after application of Cape Aloe extract. (Japan).

1979: I Suzuki;

A. arborescens was found to stimulate normal lymph cells and was claimed to have an anti-cancer effect. (Japan).

1983: I E Danhof;

Showed that fresh gel from *A. vera* increased the growth of skin cells in a dose related manner i.e. the higher the concentration of gel in the cell culture, the greater the rate of growth. (USA).

1984: A Stachow et al;

Reported that an aloe extract emulsified in oil and water increased the concentration of hydroxyproline in that part of the guinea-pig skin which had been treated daily for 1 1/2 to 4 months; the significance is that hydroxyproline is one of the main components of collagen and therefore the suggestion is made that application of aloe extract can increase soluble collagen compounds in the skin and thus postpone and reduce skin wrinkles and folds. (Europe).

1985: A Yagi et al;

A. arborescens polysaccharide extract was observed to stimulate growth of normal kidney cells taken from baby hamsters. (Japan).

1986: A Yagi et at;

A. arborescens stimulated human white blood cells to ingest bacteria and the rate of ingestion increased with the amount of extract added. (Japan).

1987: M C Botha;

Confirmed that freeze dried *A. ferox* gel stimulates the growth of normal human lymphocytes (white blood cells) as a dose dependent response. Low concentrations have little or no effect, while an increase from 50 mg to 500 mg per millimetre of cell culture medium increased the growth rate. (South Africa; unpublished).

CONCLUSION

From the previous discussion it can be seen that the claims of medical and cosmetic benefits arising from the use of Aloe and Aloe extracts are well substantiated and supported by documented scientific research.

It is also clear that the mechanisms by which these benefits arise and what in fact are the active ingredients in the Aloe leaf are factors which are not yet completely understood.

We at (O.A.A.) have embarked on a major research programme and will keep all our customers informed as to the results of the research done.

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