ALOE TODAY

Part Five

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ALOE GEL

1. INTRODUCTION

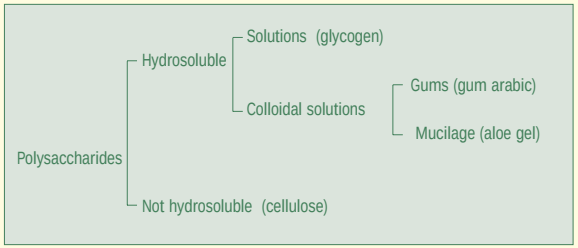
In Part Three (Natural1, November 2002) and in Part Four (Natural1, December 2002), discussion was mainly on the anthranoid components of the various species of *Aloe* which, due to their evident organoleptic characteristics (intense yellow colour, very bitter taste) and their drastic effects at gastric and intestinal level were the first to attract attention and popular and traditional use (1).

At present however, these compounds are gradually losing the interest of gastro-intestinal phytotherapeutic research because they have been replaced by compounds with a blander action (such as the so-called "mechanical" laxatives", that is of swelling, such as psyllium) pointing out, however, new horizons in the anti-tumour field (apoptosis of carcinogenic cells) of future development (see Part Four, point 5).

Great practical and scientific interest, however, is being aroused, in both the cosmetic and medical fields, by the mixture of the polysaccharide constituents (see below, Point 2) of the species, which are simply included in the definition of aloe GEL or ALOEGEL (see the diagram in Natural1, October 2002, page 42). Cosmetologists attribute soothing, cicatrizing and anti-inflammatory properties for the dermal tissues to this mixture whilst in therapy, popular use, which recommends it as an immuno-stimulant, gastric anti-acid and balancer of intestinal flora, is being increasingly supported by scientific research (see below, Point 7).

2. WHAT IS MEANT BY GEL

The polysaccharides are made up of linear or ramified chains of sugars (starch, cellulose, glycogen) which perform the most varied biological functions both in plant organisms and in animal organisms. Depending on their physical characteristics, they may be soluble or insoluble in water and can be divided as follows:



A colloid is a system made up of a solid phase dispersed in a dispersing medium: when the dispersing medium is water, the colloid is defined a "hydrocolloid" and forms dispersions called "colloidal solutions". Gels (or mucilage) are made up of solutions of hydrocolloids located inside the plant, in the vacuoles and cell walls, where they contribute to maintaining the hydration of tissues. They are made up of chains of sugars (polysaccharides) and, unlike the "gums", do not have adhesive properties.

Gums are, however, protection solutions of hydrocolloids, distributed in the peripheral organs of plants, where they perform cicatrizing functions: they emerge following cuts, abrasions and mechanical wounds, solidifying in the air, in a hard and vitreous mass; they differ from mucilage in their adhesive properties, due above all to the presence of glycoprotein polymeric chains, that is, chains of sugars with amino acids. According to the "primary" structure, that is the main polymeric chain, the polysaccharides take the name of the sugar (or sugars) that form it: we thus have mannans (from mannose), glucomannans (from glucose and mannose), galactans (from galactose), etc. They are neutral but take on acid characteristics (acid polysaccharides) if they contain acid derivatives of sugars (glucuronic or galacturonic acid) like the glucuronomannans, or from esters if a part of the OHs is present in an esterified form (acemannan with acetylmannose). A variety of chemical polymers is thus obtained, with a slightly different structure, often simultaneously present in the plant gels (also see below, Point 4).

3. OBTAINING AND PREPARING THE GEL

As already mentioned in Part Two, point 2.2, each manufacturer elaborates their own methods of extracting the gel which, in order to avoid enzymatic or thermal degradation of the components, is carried out in the shortest time possible and at temperatures that are not excessively high.

Generalizing, preferably basal leaves and which at least four years old, are cut transversally at the base, leaving first of all the bitter tasting yellow solution of anthranoids (latex) with a purgative effect, to drain away, which is separated in order to avoid it "polluting" the gel. The alternative of recovering only the actual gel or carrying out total extraction of the leaf is also proposed.

In the first case, the washed leaf is opened with a longitudinal cut and from its interior, the gelatinous tissue is removed, manually or by machine, and then disintegrated until a viscous liquid containing small portions of fibre is obtained. If the solution obtained is yellow in colour (presence of anthranoids), it is subjected to treatment with bleaching carbon (up to 1% in weight). A solution with 0.5-0.6% of dry residue is obtained from filtration, which is pasteurised [e.g. 3 min at 75-80°C (10)] and anti-ferments (e.g. 0.3% of potassium sorbate) are added.

The gel can thus be used as it is, concentrated to the volume desired for its use or dry evaporated to obtain "powder" (aloe powder) to be re-used for the various formulations. For this latter reason, spray-drying or even lyophilization (more expensive but it does not cause alterations) are used. The powder product, thus obtained, is also called "Gel 200" (or 200:1 extract, 200X extract, etc.) as it is concentrated 200 times compared to the initial residue of 0.5%.

In the second case (extraction of the whole leaf) the washed leaf is first of all opportunely bruised and often cellulase is added in order to facilitate the demolition of the cellulose tissues, operating at the appropriate time and temperature (2); pressing or centrifugation follow to separate the fibre from the colloidal solution which is made up of a gel with 1.0-2.0 % dry residue. Any subsequent operations (pasteurisation, concentration) correspond to what is stated above regarding the extraction of the actual gel.

4. THE GEL OF THE VARIOUS SPECIES OF ALOE AND ITS CHEMICAL COMPOSITION

All the species of the *Aloe* genus contain gel, with a different polysaccharide composition, but commercial use appears to be limited to those of the *arborescens*, *ferox* and *vera* species, with a clear prevalence of the latter. For this reason, the cultivation of *Aloe vera* (Barbados aloe) is spreading all over the world, including in Italy, where plantations exist in Sicily, Sardinia and Piedmont.

The mixtures of plant polysaccharides are complex and identification of their components is particularly difficult from the analytical-chemical point of view; European literature, on the subject, is still scarce and the majority of contributions on the issue come from research carried out in the United States where aloe gel has been in cosmetic use for over fifty years.

The polysaccharides of *Aloe vera* gel are made up of glucomannans accompanied by, but only in the gel obtained from the whole leaf, galactan, so that this latter gel is made up of 27-30% of galactan and 70% of gluco- and acemannan (3).

In *Aloe ferox* Mill. " at least four different partially acetylated glucomannans have been found…, an acid galactan, a mannan, an arabinan and a glucogalactomannan" (4); in *Aloe saponaria* (Hill.) Haw. mannan and glucomannan (5); in *Aloe plicatilis* Mill. a single acetylglucomannan (6), in *Aloe arborescens* a galacturonomannan (7) and a mannan [in the *natalensis* variety (8)].

As can be observed, not only the various species of aloe are similar and difficult to identify botanically, but the components of their respective gels are also not easily distinguishable. This means that it is not always possible to clarify the origin and composition of the commercial product available and, as a consequence, its real cosmetic or therapeutic efficacy.

5. ANALYTICAL TESTING OF THE GEL

According to the aforementioned considerations, analytical testing of the gel, presumably by fractioning would be considered opportune, in order to separate the various polymers according to their molecular weight. The preferred technique, for this purpose, appears to be the so-called "Gel filtration" chromatography on Sephadex which would allow this separation. However, it does not seem to be easy to perform and the therapeutic action of the individual fractions is not known, after isolation. With gel filtration it should nevertheless be possible to obtain a fairly true definition (fingerprint) of the composition of the gel.

Alternatively, the WHO Monograph (see below, Point 7) mentions a gas chromatographic method (9) without describing the conditions; more commonly the precipitation of polysaccharides with solvents (methanol, acetone) is used for the time being, which is thus described by Indian Pharmacopoeia 1996, vol. I, page 33:

"Determination
(Mucilage-Mucopolysaccharides)
Place 5 grams of sample *Aloe vera* gel in powder in a conical flask, add 100 ml water and keep agitated for two hours. Leave to rest overnight. Filter and concentrate to 10 ml. Add, under agitation, 50 ml of methanol 90% and maintain agitation for 30 minutes. Filter with paper and dry the filter with residue at 80°C, in a vacuum, until constant weight is obtained".

The results of the method may be altered by the commonest adulter-

ants of aloe gel, that is, by maltodextrins, polysaccharides obtained by the action of barley malt on wheat flour or by dextrins obtained by acid or enzymatic hydrolysis of the starch that would contribute to increasing the weight of the residue.

6. THE USE AND ACTIVITY OF ALOE GEL

All Western Pharmacopoeias contain monographs on the anthranoids of aloe, but none describes its gel. The only official monograph discussion of this product is that of the World Health Organization (10) which defines it as follows: "Aloe Vera Gel is the colourless mucilaginous gel obtained from the parenchymatous cells in the fresh leaves of *Aloe vera* (L.) Burm.f.". However, even this monograph, whilst accepting external medicinal and cosmetic use, does not recognize clinical use due to a lack of experimental evidence.

6.1 External medical and cosmetic use

The literature on the subject is very extensive and offers scientifically acquired results, including from the WHO monograph (10) which lists vulnerary and anti-inflammatory treatment of the skin, in particular against heat burns or burns from rays. At cosmetic level, the gel is recognized as having a high capacity of moisturization and protection of the tissues in creams, sun lotions, analgetic and cicatrizing unguents.

6.2 Internal medical use

Starting from the indications of popular and traditional use of aloe gel (of which the WHO monograph lists the treatment of acne, haemorrhoids, psoriasis, anaemia, glaucoma, peptic ulcer, tuberculosis, blindness, dermatitis seborrheica and fungi infections) a considerable mass of scientific experimentation, unfortunately still more at pharmacological level in vitro or in vivo in animals, than at clinical level in man, is trying to investigate further the potential immunoregulatory, anti-inflammatory, anti-ulcer, anti-tumour, anti-diabetic, anti-viral and anti-infectious activities (11). As stated above, these results have not yet been incorporated by official medical science but represent the real interest offered by the components of the *Aloe* genus for a future use of the drug, after interest for its laxative properties has waned [see also in note (8)].

7. LITERATURE

(1) Riva E., "Le vie delle spezie", G&V Edizioni, 2002.

(2) Researchers at Univera Pharmaceuticals Inc. of Broomfield (USA) have pointed out that the polysaccharides of aloe, subjected to the action of cellulase, acquire immunoregulatory properties that are greater than those of untreated polysaccharides: Zhihua Qiu et al., "Modified *Aloe barbadensis* polysaccharide with immunoregulatory activity", Planta Medica, 66 (2000) 152

(3) Cutler S.J. and Cutler H.G., "Biologically active natural products. Pharmaceuticals" CRC Press, 1999

(4) "Aloe Ferox" Information for Professional use only. VEPRO S.p.A., via Val Saviore 14/B, 25132 Brescia.

(5) Yagi et al., "Structure determination of polysaccharides in *Aloe saponaria* (Hill.) Haw., J. Pharmaceut. Sci., 73 (1984) 62

(6) Paulson B. et al., "Structural studies on polysaccharide from *Aloe plicatilis* Miller, Carbohydrate Research 60 (1978) 345

(7) Ovodova R. et al., "A polysaccharide from *Aloe arborescens* comprising galacturonic acid" Chem.Abst. (1975) 83 93833

(8) Yagi A. et al., "Aloemannan polysaccharide from *Aloe arborescens* var. *natalensis* has antitumour effect" Planta Medica 31 (1977) 17

Aloe arborescens has acquired particular popularity due to the disclosure of an anti-tumour formulation diffused by the Franciscan Father Romano Zago, a Brazilian resident in Jerusalem who had learnt of its use in his home country. From the various recipes published, here is the one on page 24 of the volume: "Di cancro si può guarire", T.Zaramella/Grafiche TPM- Padua, 1997, written by Zago .
Preparation/cancer

1. Two aloe leaves, as old as possible (4-5 years), picked in the absence of light (in the morning or evening) six days after the last rains.
2. Remove the thorns, cut into pieces and liquidize.
3. Add a cup of honey.
4. A tablespoon of grappa.
5. Place in the refrigerator.

Directions: one tablespoon three times a day (preferably before meals) for 10 days consecutively, interrupt for ten days and then begin again".
It is well known that those who prepare the mixture today also use, in addition to *arborescens* (according to Zago), other species of aloe, especially *vera*. As mentioned in point 5 of Part Three, tests of "evidence based medicine" show that the anti-tumour use of preparations of aloe gel allows a significant improvement in the quality of life. See also: Ayala D., "Aloe vera. L'uso terapeutico del gel estratto dalla foglia", Erboristeria Domani, December 1996, page 34.

(9) Hart L.A. et al., "An anti-complementary polysaccharide with immunological adjuvant activity from the leaf of *Aloe vera*" , Planta Medica, 55 (1989) 509

(10) "Aloe Vera Gel" in WHO Selected Medicinal Plants, vol I, WHO, Geneva 1999

(11) An overview on the subject, with quotations from literature, is provided by: Brassesco S. and Vinotto G. in "Aloe vera la pianta miracolosa", Archimedica Editori in Torino, 2001 and by the Aloe Vera Information Service, 23 Chapel Street, Camelford, Cornwall PL32 9PJ (GB)