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A Matter of Chemistry

It is a matter of common understanding that the chemical analysis of any complex plant is seldom achieved in one stroke. Puzzles are put together one piece at a time. Historically, the complex puzzle of Aloe Vera has followed that pattern—perhaps more than followed it, dictated it. Even among research groups who specialize in identifying phytochemical compositions, Aloe Vera is known as an extremely difficult plant to "fingerprint," and many of its mysteries remain to be uncovered.

But rather than try to detail all the historical findings about the chemistry of Aloe Vera, we will provide a brief chronological rundown of each element or group of elements as it was discovered. Later, we will separate the elements into categories and further discuss their purported effects on the human system.

Chemical History and General Findings

Historically, we know the ancient Egyptians and later the Arabs of the sixth century B.C. made extensive chemical compounds (drug aloes) and perfected their use.[33] Finally in 1851, the bitter black and brown substance from aloes was crystallized and identified as *aloin*.[34] Today, aloin is still Aloe Vera's only reference in accepted medical usage in the *United States Pharmacopoeia* and other officially recognized source books.

In 1938, Chopia and Gosh identified the main ingredients of Aloe as "aloin, emodin, chrysophanic acid, resin, gum, and traces of volatile and non-volatile oil."[35] And in 1939, Professor Tom D.Rowe and Lloyd Parks made the most extensive chemical

breakdown of Aloe Vera to that point in history. Rowe believed the curative properties of Aloe Vera would be found in the rind rather than the pulp, though he and Parks made extensive breakdowns of both. In the rind they found the enzymes *oxidase* and *catalase*. They also found the polysaccharide *pentosan* and the presence of *sulfur* and *phenols* in trace quantities. Noting the bactericidal properties of both, this was to prove significant. In the rind, Rowe and Parks also found presence of *carotene* in *beta-carotene*, a provitamin of Vitamin A; but they found no Vitamin A. The leaf-gel also showed quantities of the starch-splitting enzyme, *pentosan*. Additionally, a quantitative test of the leaf-gel revealed the presence of *oxidase* and *amylase* as hydrolizing enzymes. They were also able to define *calcium oxalate* as a chemical property in the leaf-gel. Calcium is an essential mineral; the oxalate property indicates possible uses as an alkaloid cleansing agent.[36]

Steps that followed the Rowe/Parks studies came in increments. In 1949, G.A. Bravo compared the action of anthrquinones in the human intestine relating to their action in Aloe Vera. The anthraquinones included *barbaloin, isobarbalin,* and *anthranols*. Again in 1950, Bravo further reported the studies of Maria Luisa D'Amico reaffirming the antibiotic properties in the anthraquinones found in Aloe Vera and chinese rhubarb.[37]

Anthraquinones, still broadly viewed for their purgative powers are now considered high in antibiotic properties and have an added advantage. As we will soon show, Aloe Vera is also virucidal against numerous viral strains, much of it possibly related to the anthraquinone activity.

In 1951, the search for the "key ingredient" in Aloe Vera uncovered another grouping of elements believed to have curative powers when Ikawa and Nieman found that the mucilage of Aloe Vera consisted essentially of the (muco)polysaccharides *glucose, mannose,* and *(hexo)uronic acid* along with some traces of *rhamnose*.[38] These reducing sugars, especially mannose and glucose, were believed to contain tissue-building capabilities. The (hexo)uronic acid possesses antiseptic abilities akin to urea which acts as a bactericidal as well as a cleansing agent.

In a test in Cairo in 1973 three Egyptian doctors, El Zawahry, Hegazy, and Helal, recognized that some of the attributed curative values (of Aloe Vera) were to be found in the *anthranols* (anthraquinone compounds) in the gel. Additionally, they deduced that the active healing principle existed in the *mucopolysaccharides*. They were right in part. They further credited the dramatic removal of

dead tissue to the *proteolytic enzymatic activity* in the gel. Again, they were right in part.[39]

The belief in the enzymatic activity as a prime active ingredient was also held by Drs. Ruth Sims and E.R. Zimmermann. In 1969, Drs. Sims and Zimmermann conducted a study in which they found Stabilized* Aloe Vera Gel to be both virucidal and bactericidal against a wide range of strept, staph, and monilial infections, as well as being fungicidal and antipruritic. In all their applications Sims and Zimmermann expressed the belief that it was the *proteolytic enzymes* that carried the bulk of the curative power, especially in the elimination of infected tissue.**

In recent years, the enzymatic activity has been credited with much of the penetrating power found in the Aloe Vera gel, as has lignin. And in the no man's land of yet-to-be-identified constituents of the gel, some theorists believe that a penetrating radical will be discovered closely akin to DMSO.***

The search for the "active ingredients" in Aloe Vera embraced many avenues of exploration. Aware that others were studying the carbohydrate content, Gunnar Gjerstad and G.D. Bouchey of the University of Texas (in 1968) conducted a series of studies to determine the mineral constituents of Aloe Vera and their possible effectiveness as curative agents. They found the principal organic elements in the juice were *calcium, chlorine, sodium, potassium, and manganese*.[40]

In 1971 Gjerstad and Bouchey conducted a study of *amino acids* present in Aloe Vera juice, coming to the conclusion that it contained the mucopolysacchrides *glucose* and *aldonentose* along with 18 of the 20 amino acids found in the human body. They concluded further that one tablespoon of Aloe Vera gel would contain in excess of 75 different chemical ingredients, although few ingredients were identified outside their occurrence in specified groupings.[41]

Even if we rely on the Gjerstad-Bouchey estimates alone, the numbers of ingredients believed active in Aloe Vera are considerable. And we might do well to review them, here. In the list below, we include the ingredients others have recorded in their analyses plus those ingredients that we have uncovered in our research

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** For a complete examination of the Sims/Zimmermann findings, we recommend reading Chapter 7 of the complete hardbound edition of *The Silent Healer*.

*** DMSO. A wood pulp derivative believed effective in arthritic and rheumatoid conditions, and for athletic injuries. Because of controversy over its purported high toxicity, it enjoys only limited acceptance.

along with certain key vitamins, anti-oxidants, and mild acetic compounds used in our basic stabilization formula. After this list, we will provide a definition of what beneficial potentials each ingredient possesses on its own.

Elements in Stabilized * Aloe Vera Gel

Lignin

Saponins

Anthraquinones

Aloin
Barbaloin
(Glycoside Barbaloin)
Isobarbaloin
Anthranol
Anthracene
Aloetic Acid
Ester of Cinnamic Acid
Aloe Emodin
Emodin
Chrysophanic Acid
Ethereal Oil
Resistannol

Vitamins

Vitamin B 1
Vitamin B 2
Niacinamide
Vitamin B 6
Choline
Folic Acid
Vitamin C****
Vitamin E*****
Vitamin A
(beta carotene)+

Minerals

Calcium
Potassium
(Potassium Sorbate)
Sodium
Chlorine
Manganese
Magnesium
Zinc
Copper
Chromium

**** Vitamin C. Ascorbic acid is added to existing Vitamin C content in our stabilization formula.

***** Vitamin E is added in our stabilization formula as a-tocopherol.

+ Vitamin A (beta-carotene) is activated in the stabilization process.

Mono and Polysaccharides

Cellulose
Glucose
Mannose
aldonentose
L-rhamnose

Enzymes

Oxidase
Amylase
Catalase
Lipase
Aliinase

Amino Acids

Essential

Lysine
Threonine
Valine
Methionine
Leucine
Isoleucine
Phenylalanine

Secondary

Histidine
Arginine
Hydroxiproline
Asparitic Acid
Serine
Glutamic Acid
Proline
Glycerine
Alanine
½cystine
Tyrosine

In our list of ingredients we are certain to have left something out simply because new components of Aloe Vera gel are being discovered constantly, and we are constantly trying to improve our own products without impeding the delicate natural balance that comes from the plant. And we cannot stress too strongly that the true healing qualities to be found already exist in Aloe Vera. By our unique stabilization process we have only tried to work with the properties in it, to complement them, and to prolong their life. To attempt anything beyond that would be to tamper with a perfection beyond our own.

Before we unveil the "key active ingredient" of Aloe Vera, we will at least attempt to evaluate the other components, individually.

And even a glance should give you a pretty good indication of the remarkable potentials they exhibit.

Lignin and Saponins

Lignin: A pulp-like substance existing in a formation with cellulose comprising the leaf-gel in Aloe Vera. Its presence connotes a strong ability to penetrate human skin. Any medicinal quantities it might contain are presently unknown.
Saponins: Discovered by Wasicky and Hoehne, saponins provide not only a cleansing and antiseptic capability but are also superb agents for natural sudsing in such cosmetics as shampoos.

The Anthraquinone Complex

To a degree they are still mystery ingredients. Believed to be redoubtable pain-killers, we have also come to learn that they are valuable bactericidal agents in the tradition of antibiotics minus the toxicity and plus the virucidal potentials.

Aloin: Outside its cathartic action, the importance of aloin rests in the number of anthraquinones related to it in the anthraquinone complex. Isobarbaloin and barbaloin glycosides especially add a new dimension to the curative powers of Aloe Vera even in its resin forms.

Barbaloin/isobarbaloin: A crystalline resin formed from barbaloin. Reduction products of this are the anthraquinone complexes, *anthracene, anthranols,* and *aloetic acid*. Especially effective as pain inhibitors, anthracene compounds in Aloes and chinese rhubarb were also found by Begnini (in 1950) to contain pronounced antibiotic properties.[42]

Aloe-emodin/emodin: Yellow crystalline form of Aloe Vera. Best known for its laxative effects, it also possesses certain infection-fighting qualities.

Ethereal Oil: Liquid extract related to oil of ether, it contains much of the anasthetic, analgesic properties of ether minus the specific toxicity.

Chrysophanic acid: A derivative of aloe-emodin, it is known for effective treatment of chronic diseases of the skin such as psoriasis and trichophytosis (a skin fungus).[43] On its own it exhibits certain high levels of toxicity. In the context of Aloe Vera gel, no such toxicity is measurable.

Cinnamic acid: Related to the cinnamon compounds and high in

carminative/digestive activity, these acids are believed helpful as germacides, fungicides, and detergents.

Ester of cinnamic acid: A hydrolizing or proteolytic enzyme derivative, this perpetuates the enzymatic breakdown of necrotic tissue and may act as a pain-killer.

Resistannols: Alcohol derivatives of the cinnamic acids, they are believed to have certain bactericidal capacities, although testing them in isolation does not show this.

Minerals

Our studies of the anthraquinone complex indicate that their only measureable activities are in consort with one another and in interaction with the other ingredients of Aloe Vera. Nowhere is this more evident than in evaluations of (trace) minerals. These elements are not only highly essential to the human system, they are also highly interactive with certain vitamins, co-enzymes, and proteolytic enzymes, and are greatly affected by the action of them.

Calcium: Second in importance perhaps only to iron, it is especially required for the growth of young bone tissue or the regeneration of damaged tissue. Vitamin C favors the utilization of calcium as do the amino acids, lysine and oxalic acid, with which it works in frequent combination.

Sodium, potassium, and choline: These are the basic body salts and strongly interrelated. Sodium and potassium are particularly essential in the human system. Chlorine is important in the formation of both sodium and potassium chloride and in other mineral combinations.

Zinc: Perhaps the most widely utilized of the trace minerals, zinc is closely associated with protein in foods. Lack in zinc brings about such conditions as anemia and hypoglandism. What's more, zinc seems to be a catalyst for the body proteins and therefore-provides a mystery value not yet measurable in the chemistry labs.

Manganese: Manganese is considered essential in the human system. Lack of it causes retarded growth, nerve disorders, and infertility. It also acts directly with the vitamin, choline, in fighting ataxia (defective muscular control).

Magnesium: The element in trace quantities is deemed essential. A lack of magnesium has been known to cause malabsorption syndromes, chronic alcoholism, vasodilation, convulsions, and even death. Magnesuim is interrelated with calcium and potassium in the regulation of the human metabolism.

Copper: Copper is essential to the metabolic functions and works especially with the oxidative enzymes to boost protein efficiency and efficient production of proteolytic enzymes. In that context it works to fight anemia and hypoprotein anemia.

Chromium: Chromium is significant in the human system especially for its activation of enzymes through the synthesis of fatty acids and cholesterol. Systems lacking in chromium are especially susceptible to sugar related diseases such as diabetes.

Vitamins

Even in the temples of the learned not enough is known about nutrition and the role vitamins play in it. Still, there is no question from any sector that vitamins are essential to nutrition and vital to the survival of the body in question. The word, "vitamin," literally means agent of life. Particularly when the human system becomes diseased or damaged, vitamins are quickly depleted and are among the first elements that need replacing if the body is to recover in a normal healthy fashion.

Although the extent to which vitamins are naturally present in Aloe Vera is yet to be measured, we must remember they are also catalyzing agents and interact with other elements in the body, relate directly to the proteolytic enzymatic activity, and are often agent to it.

Vitamin B 1: Also known as *thiamin*, it is directly related to appetite, human tissue growth, and energy production. Absence of it causes blood edema and neuritis.

Niacinamide (niacin): It is an enzymatic combination of *nicotinic acid* and *tryptophan* enzymes. Not only does it provide a co-enzymatic agent effective against blacktongue, it also provides hydrogen and choline agents in the metabolism.

Vitamin B 2: Better known as riboflavin, it acts as a co-enzyme in respiratory enzyme systems. Vitamin B 2 is essential in the maintenance of healthy skin, oxidation (redox) systems, and eye tissue. It is a prime agent in blood revitalization, and absence of it can bring about anemia.

Vitamin B 6: It is a co-enzyme in many phases of amino acid metabolism and is essential in the formation of growth. It is a required life-giving vitamin.

Vitamin C (ascorbic acid): Probably the best known vitamin in the world, Vitamin C is most frequently proclaimed for its uses as a disease preventative. Although there is some Vitamin C already native to the Aloe Vera gel, we add additional amounts in our

stabilization formula for a couple of reasons. First, it acts as an effective anti-oxidant. Second, it acts as a triggering mechanism to activate other elements such as calcium and folic acid for a more effective utilization of their potentials.

Vitamin E: If any element closely parallels the many facets of the healing plant, it is this vitamin. It is directly related to skin health and the growth of healthy tissue especially in such organs as the liver, kidneys, and genitals. Applications in high doses are believed by proponents to help overcome infections of all sorts. In recent years, it has been used both topically and internally to treat burn patients. And there are some reports to indicate that it is highly effective against carcinogens (cancer-causing agents) in such forms as cigarette tars and gases, nitrites, and other high level toxics.

It is present in trace quantities in Aloe Vera leaf-gel. We add Vitamin E in stabilization because like Vitamin C it is an effective antioxidant. Further, it helps to trigger the vitamin, *choline*, in the system and combines with such elements as carotene to activate the Vitamin A potentials in the gel.

Choline: Choline works well with Vitamin E in the metabolism of fatty tissue and enzymatic activity. It also works to prevent liver and kidney disorders and is considered essential in the regeneration of tissue.

Folic Acid: Folic acid is another vitamin that appears to work best in consort with other vitamins and is especially triggered by Vitamin C which seems to help facilitate its participation in the enzymatic activity. Folic acid has been found useful in the building of blood and in combating various types of anemia.

Some vitamins and minerals are present in Aloe Vera only in trace quantities, but we have received some indication of the catalytic effect they have on one another and on the body's enzymes. To be sure, according to current standards of scientific measurement, vitamins and minerals can take no specific credit for facilitating the healing process. Most have failed in isolation forms of testing as have the anthraquinone compounds we have detailed previously.

The "active ingredient" is of course the key sought by scientific research to unlock the mystery of Aloe Vera so that its credibility may be permanently established.

We had promised earlier to disclose what we believed to be that ingredient. And before we discuss the effects of the mono and polysaccarides, the proteolytic enzymes, and the amino acids in

Aloe Vera and their contributions to its curative powers, we feel obligated to reveal the active ingredient—it is actually a *synergism.*

Synergism literally means the joint action of two or more ingredients to create an effect on the whole that is greater than the sum of its parts.

Taken alone, many of the elements we have mentioned promise considerable curative potentials as well as being considered essential to the human body. And we have been given a glimpse of the strong interrelationship between many of the anthraquinone compounds, the minerals, the vitamins, their triggering effects on one another, and their utilization in the regulation of body sugars, enzymatic activity, and amino acid complexes.

Even an abbreviated review brings us to some idea of the possible synergistic implications. For example, we have already learned that calcium is best utilized in consort with Vitamin C and the essential amino acid, lysine. Vitamin C also works to facilitate the use of choline in the system. Vitamin E works in combination with carotene to form beta-carotene, the Vitamin A complex. We know that amino acids, methione and cystine work in the formation of sulfur in the body. And we have yet to learn that Vitamin E in combination with the enzyme amylase and carotene agents works toward the formation of *alpha amylase*, a starch splitting enzyme known for its use as an anti-inflammatory agent. Said to initiate by an "unknown mechanism" a healing response to a wide scope of tissue trauma, alpha amylase is just one of the proteolytic enzymes in the enzyme complex. In fact, nothing illustrates the significance of synergistic activity more accurately than the enzyme complex itself.

If we are to be able to understand the importance of that synergism in examining the *mono* and *polysaccharides, enzymes,* and *amino acids* found in Aloe Vera gel, we need first to understand which ones are present in the plant itself, and second how they work in the human body.

Mucopolysaccharides. Enzymes. Amino Acids.

The mucopolysaccharides identified in Aloe Vera to date are: *cellulose, glucose, mannose, uronic acid, aldonentose, and L-rhamnose.*

The enzymes currently identified are: *oxidase, catalase, amylase, lipase,* and *aliinase.*

The amino acids identified in Aloe Vera gel are: *lysine,*++

threonine,++ valine,++ methione,++ leucine,++ isoleucine,++ phenylalanine,++ histidine, arginine, hydroxiproline, asparitic acid, serine, glutamic acid, proline, glycerine, alanine, ½cystine, and *tryosine.*

In the case of enzymes, we have been able to isolate and identify only five. Yet, from the evidence of the reducing sugars and amino acids present, we can safely estimate the possible existence of at least another twenty or thirty.

There are twenty amino acids that need to be present in the healthy human system. Eight of them are considered essential, because the body cannot manufacture them on its own. In Aloe Vera, eighteen of the twenty amino acids have been found and seven of the eight essential amino acids. The eighth, *tryptophan,* though it has never been identified, is known to be a constituent in the niacinamide complex. So the possibility certainly exists that the amino acid complex present in Aloe Vera is a complete one.

Understanding Some Body English

It is now that we must deal in hypotheticals. It is a hypothesis based on the belief that the body contains within itself the power to heal if given the proper signals, the right phytochemical message to do so. And in the world of "what if," what if there were a botanical element to provide the perfect complement to the biological needs of the human system, a plant that approximates the elements that the body needs to stay healthy? What if it contained all the vitamins and minerals and natural healants, all the reducing sugars and proteolytic enzymes needed to rush those healing messages into the trouble spots? Let us assume that these elements for healing and revitalization of tissue are not measurable in isolation but are instead triggered as needed and rushed to the diseased areas through the incredible penetrating powers of lignin and the proteolytic enzymatic activity. The proteolytic enzymes work with the potentials in the anthraquinones and detergent agents to tear down the diseased tissue and bacteria. The amino acids work with the vitamins and minerals to build the system back up.

Think about the elements found in Aloe Vera. Think about the elemental needs of the human body. Add the factor of Aloe Vera's ability to penetrate through tissue. The lignin and proteolytic enzymes bring about penetrating abilities in the plant that cannot be

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++ Essential amino acids.

denied anymore than they can be explained away in lab tests, and perhaps we shouldn't try. What we should try to do is grasp the true meaning of synergism, for it is in that quality that the secret of Aloe Vera lies.

Summary

At this point we have at least some understanding of the chemical composition of Aloe Vera. We know it is comprised of several anthraquinone compounds, indicating the presence of pain-killing abilities plus broad spectrum bactericidal potentials which probably surpass those in antibiotics. Additionally, Aloe Vera is known to contain some analgesics, infection fighters, penetrants, vitamins, and minerals that function as both nutrients and catalyzing agents for other curative components all acting synergistically to provide a natural botanical complement to the biological needs of the human body.

Furthermore, there is strong evidence to support the belief that those elements rush healing reinforcement to the specific area of the body in need through strong lignin penetration and highly active proteolytic enzymes. Because of Aloe Vera's enzymatic activity we not only have a remarkable penetrating power and accelerated degeneration of dead tissue, we also have a strong foundation upon which to rebuild healthy tissue through the amino acid complex.

From our toxicology reports, we have considerable evidence to support the claim that Aloe Vera produces no side-effects on the human system.+++ What's more, hundreds of physicians' reports in thousands of cases will again verify this utter lack of toxicity in *in situ* patient applications.++++

In the next chapter, "Dramatis Curae," we will review some of the *in situ* findings of physicians, some extensive bacteriological studies, some dramatic case histories, and some viable letters of testimony.

+++ For a complete examination of our toxicology data, we refer you to Chapter 6 of our complete hardbound version of *The Silent Healer.*

++++ Physicians' reports *en toto* are included only in Appendix A of the complete hardbound version of *The Silent Healer.*