

Automation In New Health-Benefit Beverage Industry

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ABSTRACT

Considering the population growth of India and some of the other countries of the world there is a rapidly growing demand for all kinds of beverages to combat the global requirement of the healthy beverages. The high quality and quantity of Indian agriculture health-benefit produce like tomato, mango, apple, orange, carrot, grape, pineapple in the conventional categories and other new produce with medicinal properties such as Aloe Vera, Jamun, Amla and sea-buckthorn (berry) etc.

India is now ready for export of new kind of beverages without creating local shortages.

For quality and timely delivery of the beverages at the right prices it requires a planned production, storage and distribution to compete in the market and attract the user for the new health benefit beverages. The paper describes automation technology in the beverage industry for organized production for new health-benefit beverages.

Key words: health, beverages, automation

HEALTH BENEFITS BEVERAGES

Health Benefits beverages can be created from some of the agricultural produce that are almost a boon to human beings because their overall health benefits and properties as anticancer and anti-oxidant. Some of these also have life saving properties, like: Green Tea, Aloe Vera, Amla, Tulasi and Ginger India produces many such fruits which have anticancer properties in addition to overall health benefits. To present some of these as palatable beverages a

combination has to be created for a taste that appeals to all ages. For example the sourness of the Amla can be overcome by blending its juice with another equally healthy produce with anticancer properties such as Tulasi, Ginger, seabuckthorn berry and other wild blue berry, black berry, strawberry or and sweet cherry. A very good combination is Amla-grape juice (anti-oxidant). Apart from a healthy and tasty beverage wine can also be produced with this combination. Fruit mixed beverage having composition 30% Amla and 70% Grape juice, 0.3% yeast, 0.4% acidity, 15.24 degree centigrade mix was found to be optimum among the other formulation. It is concluded that Amla berries can be used as a valuable ingredient for the production of mixed fruit beverage with all the important properties and medicinal characteristics of Amla and grape fruits. This can thus, prove to be a good health drink with phenolics, vitamin C as antioxidant.

Use of *Aloe Vera* in nutritional, pharmaceutical and cosmetic preparations draws attention for generation of scientific information. Looking to the importance of biologically active components possessed by the leaves of the *Aloe Vera* plant and its wide spread use, it has become imperative that, the leaf should be processed with the aim of retaining essential bioactive components. In this review paper, *Aloe Vera* gel expulsion, gel extraction and storage of gel are critically described from different references. *Aloe Vera* processing methods for gel expulsion by

splitting of leaf, roller method, crushing of whole leaf, hand filleting methods and stabilization are described with various references. Present processing techniques aims at producing best quality aloe products but end aloe products contain very little or virtually no active ingredients. Hence, appropriate processing techniques should be employed during processing to extend the use of *Aloe Vera* gel.

Proper scientific investigations on Aloe Vera have gained more attention over the last decade due to its reputable, medicinal, and pharmaceutical and food properties. Some publications have appeared in reputable scientific journals that have made appreciable contributions to the discovery of the functions and utilizations of Aloe Vera lacking processing of leaf gel. Present processing techniques aims at producing best quality aloe products but end aloe products contain very little or virtually no active ingredients. Hence, appropriate processing techniques should be employed during processing in order to extend the use of aloe Vera gel. Further research needs to be done to unravel the myth surrounding the biological activity and the exploitation of aloe constituents.

Phyllanthus emblica, commonly known as Amla is widely distributed in tropical and subtropical areas and has therapeutic potential against deleterious diseases. It is becomes a notable fruit for its rich amount of vitamin C, polyphenols such as tannins, garlic acid, elegendic acid, flavonoids like quercetin and rutin.

Amla is a natural, efficacious, an antioxidant with the richest natural source of Vitamin C. These berries have the highest amount of naturally occurring vitamin C of any ripe fruit in the world used as a traditional food. Numerous studies conducted on this fruit suggest that it has anti-viral properties and also functions as an anti-bacterial and anti-fungal agent. The gelatinous plum-sized Amla fruit contains naturally occurring vitamin, heat stable vitamin C. A clinical study on patients with pulmonary tuberculosis

showed that the vitamin C contained in *Embllica officinalis* was better assimilated than synthetic vitamin C. Further research of contemporary and traditional medical literature indicates that Amla either in combination with other herbs or alone has been useful in the amelioration of colds, warts, skin afflictions, influenza, anemia, diabetes, lung conditions, elevated cholesterol and as an immune restorative in cancer conditions. It is one of the best natural antigenic remedies *Embllica officinalis* is used in treatment of Acne and other skin problems.

This is amazingly effective natural anti-ageing produce. It is very effective in treatment of Acidity and Peptic ulcers. It is rich in Vitamin C, Calcium, Iron, essential amino acids and other vitamins and minerals and anti-oxidants. Regular Use of this fruit improves immunity, fights cancers, and rejuvenates the body. It fights chronic diseases like hypertension, high Cholesterol, Diabetes, AIDS, influenza, chronic cough and cold, Chronic infections, Chronic fatigue and Chronic inflammatory conditions. Ayurvedic describes it as one of the best herbs for Diabetes, bleeding disorders, strength and stamina promoter.

BENEFITS

Automation greatly decreases the need for human labour and mental requirements and plays an increasingly important role in the world economy. Chandra Udayana et. al. in their paper [1] describe about the study of communicating two Schneider TSX Micro 37-21 PLCs in order to miniature of beverage production. The usual (and expensive) way to communicate them is using converter module TSX P ACC 01. Less expensive way uses original converter cable TSX PCX 1031 that connect to the ports of PLCs (TER and AUX port) which will be explained here. PL7 Pro V 4.0 software is used to program the PLCs. The communication cannot be established due to some improper addressing. The exploration is continued to the serial communication.

In figure 1 the first section is controlled by PLC 1, and the second one is controlled by PLC 2. Look at figure 1. The raw material processing plant consists tank A and B Amla & grape liquids and tank C for mixing these liquids, tank D for heating the liquid, 2 water level sensor in tank A and tank B, mixer, heater, 2 valves and 2 pumps. After the raw material that is the liquid has been processed, it will be filled into the glass that is moving on a conveyor. These filler plants consist of: conveyor with AC motor as its mover, filler carousel as the heart of this filler which has DC motor as its mover, glass pooler which has DC motor as its mover, valve, and limit switches to sense the glass position. Figure 9 shows the side view of the plant design.

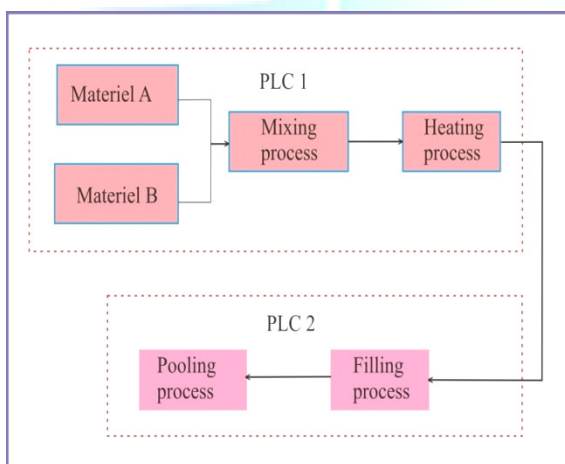


Fig 1 General block diagram of plant for mixing Amla and Grape juices

PLC – PC communication needs a converter because PC uses RS 232 serial communication, while PLC uses RS 485 (multipoint) serial communication. Multipoint serial communications used by PLC produce differential voltage (peak to peak): 5 Volt.

The results of the objective HPLC analyses [2] reveal several important findings: (i) the total sugar content of popular sugar- sweetened beverages vary from the information provided. By the manufacturer/vendor with

some having more and some having less sugar than the label; (ii) the fructose to- glucose ratio in the HFCS used in various beverages varies and is nearly always higher than 55%, with several major brands at 65% fructose, and there is within-brand variation in the fructose- to-glucose ratio in different sources of drinks, i.e., bottle vs. fountain; and (iii) the type of sugar listed on the label is not always consistent with the type of sugar detected by the HPLC analysis.

[3] Energy drink consumption may be a potential health hazard for youth due to high levels of caffeine and novel ingredients not normally found in the food supply. The American Academy of Paediatrics (AAP) stated that ‘energy drinks have no place in the diet of children and adolescents’ due to their ‘stimulant content’, but energy drink manufacturers continue to advertise directly to adolescents in media also viewed by children.

[4] T.Kalaiselvi¹, R.Praveena², Aakanksha.R³, Dhanya.S⁴ have develop an automatic bottle, filling and capping system with a deduction mechanism using sensors. Automatic filling process for all the bottles simultaneously with a user defined selection for volume to be filled. Bottles are kept in position in a carton over a conveyor belt. IR sensors are used for sensing the bottles. Depending on the output of the sensor the corresponding pumps switch on and the filling operation takes place. If the particular bottle is not present then the pump in that position is switched off, thereby avoiding wastage of the liquid. The filling is done based on timing. Depending on the pre-set value of the timer the pump is switched on for that particular period for the filling.

The input module includes the IR sensors and level sensors. There are four or five pairs of IR sensors whose output is given as an input to the PLC. Three pairs of IR sensors are used for detecting the bottles at the input and one is used for sensing the bottles for filling and capping. The 3 IR pair sensors kept near the input side, where the

bottles are fed into the conveyor. This is called *Detection Sensors* and the one used for stopping the conveyor at the filling and capping operation side is called the *Stop Sensor*. Seven levels sensors used; two level sensors are used in tank 1 (concentrate tank) to denote the high level and low level and similarly two sensors in tank 2 (tank containing water).

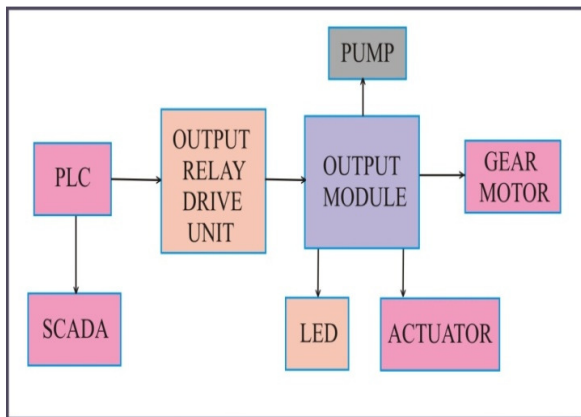


Fig 2 SCADA Architecture of Plant Process [4]
T.Kalaiselvi

The output of the sensors is not given directly to the PLC as the input voltage to the PLC should be 24V. Hence these are given through signal conditioning circuits which condition the input signals fed to the PLC. For safety purposes the inputs to PLC given through relay circuits. The relay consists of 3 terminals: Common, NO and NC. The 24V which is fed into the PLC is available in the common terminal. Hence depending upon the necessity of signals, the circuit closes or opens thereby connecting to the PLC.

PLCs are well-adapted to a range of automation tasks .All control operations (filling and capping) are monitored using PLC. The entire bottling process is automated by feeding the necessary conditions into the PLC using ladder logic. Ladder logic is one of the methods of programming a PLC. Thus, depending on the logic developed the various

operations take place and the filling and capping of bottles is performed. PLC consists of an *Input and Output Unit, Central Processing Unit, and a Memory Unit*. All logic and control operations, data transfer and data manipulation operations are done by the central processing unit. The results are stored in the memory of the PLC.

The operating voltage of the output devices is low when compared to that of the PLC. The output of the PLC is 24V whereas output devices such as gear motors and pump require only 12V. Hence the output signals from the PLC are given through a relay drive unit which drives the output devices by supplying the optimum voltage required for their operation.

Various output devices used in the bottling process are gear motors, pumps, actuators and LED's. These are connected to the output module. The gear motor is used to run the conveyor in forward direction. Five pumps used for the filling process out of which three pumps are connected to the process tanks and the remaining two pumps to the concentrate (tank 1) and water tank (tank 2). Actuators are used for capping the bottles. The actuator applies a force on the caps which in turn corks the bottles tightly.

[4]The main objective of their paper is to develop a bottle filling and capping system based on certain specifications. It includes a lot of features like user defined volume specification etc. were added in the different stages in their work and the desired results were obtained. PLC was used to control the various operations and monitoring was done using SCADA.

VK Chandegara1, AK Varshney [5] highlight that *Aloe Vera* plant has potential in pharmaceutical, nutritional and cosmetic applications. The leaf of *Aloe Vera* plant contains biological active compounds, which needs careful harvesting and handling. Temperature is the main factor in processing *Aloe Vera*. The processing and handling should

be carried out at low temperature to preserve its active ingredients'. The quality of *Aloe Vera* gel should be evaluated in terms of viscosity of gel, optical density, and refractive index. *Aloe Vera* gel expulsion by splitting of leaf, roller squeezing method and crushing of whole leaf: *Aloe Vera* gel should be freeze dried to maintain biological properties as it contains active compounds. After extracting the gel, the stabilization of gel is necessary for its long duration storage and product formulations. Hence, appropriate processing techniques should be employed during extraction in order to have effective use of *Aloe Vera* gel.

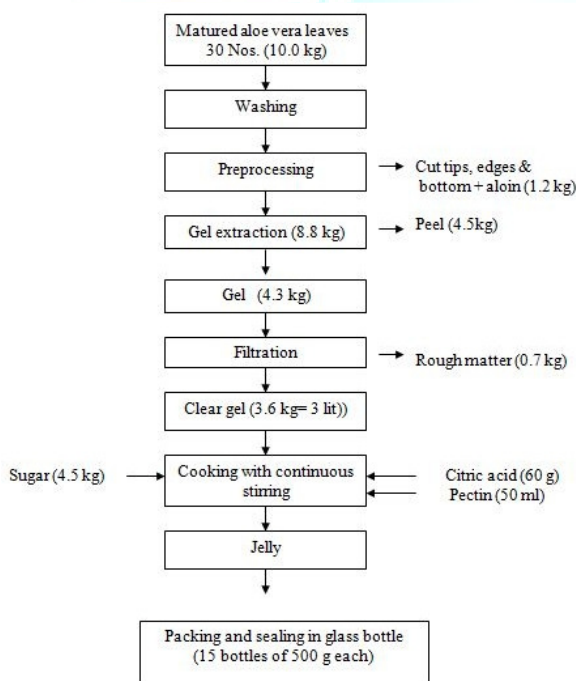


Fig: *Aloe Vera* L. processing and products: A review ARTICLE Vol. 3, No. 4, pp. 492-506, December 2013 VK Chandegaral, AK Varshney.

C.T. Ramachandra and P. Srinivasa Rao [6] indicates that *Aloe Vera* as a highly potential functional and valuable ingredient that exhibits relatively impressive biological functions of great interest in cosmetic, pharmaceutical and food industries. It also revealed the present processing

technologies viz., gel stabilization technique, biological activity of aloe leaf gel and the effect of heat treatment on various constituents of gel. The process technologies like desiccant dehydration of aloe cubes, Qmatrix process, low temperature short time heat treatment process, active aloe process, Time Temperature and Sanitation Process total Processes of *Aloe Vera* is the potential innovative process technologies.

K.P. Sampath Kumar*, Debjit Bhowmik et.al [7] Highlight Amla is one of the richest natural sources of vitamin C, its fresh juice containing nearly twenty times as much vitamin C as orange juice. A single Amla is equivalent in vitamin C content to large oranges. Clinical tests have shown that this high concentrate is more quickly assimilated than the synthetic vitamin. It is an ingredient of many Ayurvedic medicines and tonics, as it removes excessive salivation, nausea, vomiting, giddiness, spermatorrhoea, internal body heat and menstrual disorders. Because it is also cooling, it is an excellent liver tonic.

Datta Mazumdar, S., Poshadri, A., Srinivasa Rao, P., Ravinder Reddy, C. H. and Reddy, B.V.S [8] present work that demonstrates a new method of clarification of sweet-sorghum juice in order to obtain food grade syrup with acceptable organoleptic properties. Using this syrup, shelf stable, squash and RTS beverages were developed and their formulations optimized. From this study it can be concluded that sweet sorghum juice and syrup have a potential to be used in development of commercial beverages.

The beverages can be further fortified or blended with other fruit juices, fruit concentrates, protein concentrates etc. In addition the syrup itself has a good nutritional profile and potential to be sold directly as health syrup. Future work shall focus on exploring packaging options for the developed products, market research, in order to gain consumer insight, to understand the marketability of the

developed products, identifying suitable varieties of sweet sorghum for food grade syrup production and exploring the use of sweet sorghum syrup as a sugar alternative in different food product categories.

Saloni Jairath, Parampal Sahota and Gulab Pandove [9] presented here to redress the problems of horticulturalists by minimizing the post-harvest losses, avoid fruit and vegetable glut in the market, and ensure efficient utilization of astringent, highly nutritive fruits in the form of non alcoholic naturally carbonated beverage with the retention of nutrients and maintaining nutraceutical properties of fruits for a period of three months.

Poonam Mishra, Vijeya Srivastava, Deepmala Verma, O. P. Chauhan and G. K. Rai [10] present study a comparative of wild variety and cultivated variety of *Amla* were carried out; simultaneously effect of different drying techniques on physicochemical properties of *Amla* powder were also studied. The fruits of wild variety were found smaller than the cultivated variety. In case of wild variety, the total phenolics contents were found to be 32.32 g/100 g of gallic acid equivalent (dwb), whereas Chakiya variety had 24.50 g/100 g of gallic acid equivalent (dwb). The fruits of Chakiya variety were used to prepare the powder by different techniques like freeze drying, sun drying, spray drying, hot air drying and vacuum drying. Powder yield varied with type of drying method as sun drying (10.11%), tunnel drying (8.78%) and vacuum drying (12.48%), spray drying (4.90%) and freeze drying (2.23%). Significant differences ($p < 0.05$) in chemical composition of *Amla* powder were studied when prepared by different techniques. The freeze dried powder had the highest ascorbic acid content followed by spray dried powder. The lowest concentration of ascorbic acid was found in sun dried powder. Freeze dried samples showed maximum mineral contents in terms of calcium (79.6 mg/100 g), phosphorus (12.38 mg/100 g) and iron (88.03 mg/100 g). *Amla* (var. Chakiya) can be used for development of value

added products. This variety had a lower content of phenolics content, total soluble solids and ascorbic acid as compared to wild variety. However, in terms of average weight, length and diameter, the fruit of this variety was found better than wild variety. The powder made from this variety showed better retention of nutrients and colour in the case of freeze dried samples followed by spray dried ones.

Apoorva M Kakde, N.P. Awate [11] indicates that *Amla* punching machine is efficient to punch the *amlas* which is used for preparing the *murraba*. This is the modern technology mentioned in the study for preparation of *amlas* *murabba* is hygienic, consume lesser time and provide maximum retention of nutrients.

Various articles on internet Wikipedia give information about some these produce.

CONCLUSIONS

The paper highlights the new health benefit beverages which have tremendous health benefits apart from being palatable. These new beverages can be produced even by Small Scale Units with low cost SCADA automation and the product can be launched in competitive market successfully for its double action that is taste and health. The paper outlines certain combinations of juices which have not been prepared hither to.

Juices in different proportions were used to obtain the correct taste and health benefits received by consuming ½ liter of the beverage bottle. *Amla* also blends well with orange, pomegranate and pineapple. Right selection of blend is necessary for the beverage to climb the market list. Small scale industry can be launched immediately to capture the market.

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APPENDIX

OTHER HEALTH BENEFIT

GREEN TEA

1. Green tea and cancer: Green tea helps reduce the risk of cancer. The antioxidant in green tea is 100 times more effective than vitamin C and 24 times better than vitamin E. This helps your body at protecting cells from damage believed to be linked to cancer.
2. Green tea and heart disease: Green tea helps prevent heart disease and stroke by lowering the level of cholesterol. Even after the heart attack it prevents cell deaths and speeds up the recovery of heart cells.
3. Green tea and Anti-aging: Green tea contains an antioxidant known as polyphenols which fight against free radicals. What this means it helps you fight against aging and promotes longevity.
4. Green tea and weight loss: Green tea helps with your body weight loss. Green tea burns fat and boosts your metabolism rate naturally. It can help you burn up to 70 calories in just one day. That translates to 7 pounds in one year.
5. Green tea and skin: The antioxidant in green tea protects the skin from the harmful effects of free radicals, which cause wrinkling and skin aging. Green tea also helps fight against skin cancer.
6. Green tea and arthritis: Green tea can help prevent and reduce the risk of rheumatoid arthritis. Green tea has benefit for your health as it protects the cartilage by blocking the enzyme that destroys cartilage.
7. Green tea and bones: The very key to this is high fluoride content found in green tea. It helps keep your bones strong. If you drink green tea every day, this will help you preserve your bone density.
8. Green tea and cholesterol: Green tea can help lower cholesterol level. It also improves the ratio of good cholesterol to bad cholesterol, by reducing bad cholesterol level.
9. Green tea and obesity: Green tea prevents obesity by stopping the movement of glucose in fat cells. If you are on

a healthy diet, exercise regularly and drink green tea, it is unlikely you'll be obese.

10. Green tea and diabetes: Green tea improves lipid & glucose metabolism, prevents sharp increases in blood sugar level and balances your metabolism rate.

AMLA JUICE

1. Amla juice is a must for eyes, hair growth and heart, lowers LDL level and cholesterol. A very Good appetizer cures acidity, peptic osteo arthritics and genealogical Problem.
2. Amla juice is a natural rich source of energy, very Rich with Vitamins "C", and minerals. It enhances physical & mental health. It rejuvenates the body by increasing immunity and enhancing memory & specially the eye sight.
3. Svitemblica Amla juice is very nutritious and it fights against ageing.
4. Amla juice increases red blood cell count and hemoglobin percentages, and patients started their anabolic phase (metabolic processes involved in protein synthesis) sooner. Svitemblica Amla juice reduces cholesterol levels.
5. Amla juice reduces unwanted fat because it increases protein levels; because of its ability to create a positive nitrogen balance and it also significantly reduces the levels of free fatty acids.
6. Drinking Amla juice will also help for relief in the poisonous effects of insects.
7. Drinking Amla juice in the morning makes the complexion glowing and blemishes less.
8. It is involved in the metabolism of TYROSINE and PHENYLALANINE which are turn involved in the formation of MELANIN PIGMENT giving Natural health to the skin.

Many medicinal virtues have been attributed to Indian Amla.

Respiratory Disorders

This medicinal tonic is highly beneficial in fighting various respiratory disorders. It is especially valuable in seasonal cough and cold. Amla is also useful in recurrent respiratory infections such as tonsillitis, sinusitis and sore throat.

Amla, with its high vitamin C content, is considered valuable for diabetics. Amla along with a cup of fresh bitter gourd juice, taken daily for two months will stimulate the islets of Langerhans i.e. -the isolated group of cells that secrete the hormone insulin. It therefore, reduces the blood sugar in diabetic patient. Diet restrictions should be strictly observed while taking this herb. Being the best eye toner, it will also prevent eye problems as complications of diabetes.

Heart Disease

Amla (Indian gooseberry) is considered as very effective remedy for heart diseases. It tones up the heart muscles and makes them strong. The heart then pumps the blood flawlessly throughout the body. Amla is also known to build the health by destroying the heterogeneous elements and regenerating the body energy.

Eye Disorders

The Amla, taken with honey, is useful in preserving eye sight. It will also be beneficial in the problem of conjunctivitis and glaucoma. It reduces intraocular tension in an effective manner. Generally, two capsules twice a day with 1/2 cup of Amla juice can be taken mixed with honey twice daily works in most of the cases.

Prevents Aging

Amla has revitalizing effects. It contains an element which is very valuable in preventing aging and in maintaining strength in old age. It improves body resistance and protects against infection. It strengthens the heart, hair and different glands in the body. It is said that the great ancient sage Muni Chyawan rejuvenated himself in his late 70s and regained his virility by the use of Amla.

Hair Tonic

Amla is an accepted hair tonic in traditional recipes for enriching hair growth and hair pigmentation. Amla is excellent for strengthening the roots of your hair and maintaining its color and luster.

Liver Functions

Regular use of pain killers, antibiotics and medication, regular intake of alcohol, all cause toxin build-up in the

liver. Amla helps in strengthening the liver, and removes the toxins.

ALOE VERA

When used externally, aloe is the best wound dressing ever discovered. It works by simultaneously sealing the wound while attracting an increased flow of blood to the wound, accelerating wound healing.

The Aloe Vera actually heals gums and eliminates gum disease, mucositis, lip fissure and mouth herpes lesions.

Polysaccharides in the Aloe Vera plant have curative effects on numerous digestive disorders. The Internet is a storehouse of information and testimonials about Aloe Vera curing IBS, ulcers, Crohn's disease, ulcerative colitis and other disorders of the digestive tract. This is one of the best known applications of Aloe Vera gel.

Pain in the joints and muscle pain occurred due to arthritis is reduced by the application of Aloe Vera sprays or gels.

It protects the kidneys from kidney infection and urinary tract infection it prevents kidney stones and protects the body from oxalates in coffee and tea.

The asthmatics were able to cut down on their usage of inhalers, including the steroid inhalers. These effects were probably due to Aloe Vera's innate anti-inflammatory effect as well as its effect on the immune system.

It makes vitamin C, E and other antioxidants work better! It actually potentiates antioxidants, probably due to its' effect on enhancing blood quality and allowing the blood to more effectively transport oxygen and nutrients to the cells of body. The gel of Aloe Vera provides benefit in reducing triglycerides, total cholesterol and blood fat lipid and blood sugar levels.