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ADVANCES IN HERBAL PROSPECTS PROCESSING AND FOOD PRODUCTS RESEARCHES ON ALOE VERA: A REVIEW

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ABSTRACT

In recent years, *Aloe vera* has become a subject of interest because of its beneficial effects on human health. The present review envisages the therapeutic properties of *A. vera* based on literature available on various uses. Reviewed data revealed that this novel herb has anti inflammatory, antioxidant, antimicrobial, anticancer, anti-diabetic, immune boosting and hypoglycaemic properties. This promotes human health without any side effects. Daily supplementation with this is effective against various disorder and diseases like stroke, heart attacks, leukaemia, anaemia, hypertension, AIDS, radiation burns, digestive disorders *etc.* Due to the medicinal properties of *Aleo vera*, it has been used as a novel functional foods production of gel containing health drinks/beverages and pharmaceuticals among them *Aloe gel/juice* are most popular products. Today *Aloe gel* is being used in hundreds of skin lotions, sun blocks and cosmetics. Researches also indicate its anti-inflammatory properties due to its polysaccharides content in leaves. The five unique properties of *aloe* is deep penetration antiseptic, stimulates cell growth and new tissues, clearing effects on nervous system, dietary fibre, normalization of metabolic path way. It is being extensively preferred as a natural product with medicinal and therapeutic properties.

Key words: *Aloe vera*, Food applications, Medicinal benefits, Herbal benefits, Processing.

INTRODUCTION

Aloe vera commonly known as Gheegwar/Ghritkumari belongs to family lilaceave. It is a desert plant having a very popular herbal remedy. Aloe is derived from Arabic word “alloeh” means “bitter”. *Aloe vera* leaf contains 95% of water, 75 nutrients, 200 active compounds, 20 minerals, 18 amino acids, 12 vitamins and 92 enzymes. It can be used as the source of vitamins like A, B1, B2, B6, B12, C, E, Folic acid, Niacin *etc.* Owing to its succulent properties, it is a rich source of nutrients and essential minerals. Aloe plant is very much prevalent in hot and dry climates. It is among the oldest known medicinal plants gifted by nature; hence often called miracle plant, known by many names. The aloe plant has long (up to 20 inches long and 5 inches wide), triangular, fleshy mucilaginous leaves that have soft spikes along the edges. The fresh parenchymal *gel* from the centre of the leaf is clear. There are more than 300 species of *Aloe vera* and of these only 4 or 5 are commonly used in medicines. The most widely used species of *Aloe vera* is *Barbadensis millar*. *Barbadensis miller* is not a cactus but is a cactus like plant with a rubber touch growing in the warmer tropical climates of the world. Numerous aloe species around the world are used for conditions ranging from

dermatitis to cancer. Aloe gel’s greatest use is as a skin salve and vulnerary for minor burns, abrasions, canker sores and other epithelial injuries. There is growing experimental evidence for its use as an antiviral, an ulcer remedy and an adjuvant cancer treatment due to its immune modulating effects.

Due to its high nutritional value it can be incorporated as base food products like aloe juice, aloe squash, to get nutritional food to human health. Thus it is very popular among the world's population. Aloe juices and gels are available in the market to be used for various purposes. *Aloe vera gel* contains all the essential nutrition for a daily requirement. Therefore there are many companies that are involved in preparing *Aloe vera* juice and edible gels. *Aloe vera* leaf is processed by boiling, pasteurization and cold processing.

CHRONOLOGY OF USES

Ancient Egyptian papyrus and Mesopotamian clay tablets describe aloe as useful in curing infections, treating skin problems and as a laxative (Shelton, 1991). Cleopatra was said to include aloe cream in her beauty regimen (Haller, 1990). Aloe was used by Hippocrates and Arab physicians and was disseminated to the Western

Hemisphere by Spanish explorers. Legend has it that Alexander the Great captured the island of Socotra in the Indian Ocean to secure its *aloe* supplies to treat his wounded soldiers (Atherton, 1998).

Approximately, 325 species of Aloe are known, and most of them are indigenous to Africa. *Aleo barbadensis* is native to North Africa and was introduced into the island of Barbados in about 1630. A variety of *aleo barbadensis* (Figure1) was introduced by William Anderson into Curacao in 1817 from China. The Chinese describe aloe's skin and the inner lining of its leaves as a cold, bitter remedy which is downward draining and used to clear constipation due to accumulation of heat (fire) (Bensky *et al.*, 1993). In Ayurvedic medicine, the traditional medicine of India, aloe is used internally as a laxative, anti helminthic, haemorrhoid remedy, and uterine stimulant. In Arabian medicine, the fresh gel is rubbed on the forehead as a headache remedy or rubbed on the body to cool it in case of fever as well as being used for wound healing, conjunctivitis and as a disinfectant and laxative (Ghazanfar, 1994).

Today *aloe vera* gel is an active ingredient in hundreds of skin lotions, sun blocks and cosmetics. The gel is used in cosmetics has been boosted by claims that it has similar anti-aging effects to vitamin A derivatives. Aloe first gained popularity in the United States in the 1930's with reports of its success in treating X-ray burns. Recently, aloe extracts have been used to treat canker sores, stomach ulcers and even AIDS. It is also a natural healer and hence any internal ulcers or lesions will be soothed and healing will be enhanced (Wright, 1936; Collin & Collin, 1935). *Aloe vera* leaves have vital ingredients such as vitamins, minerals, amino acids, polysaccharides, enzymes, plant steroids, saponins, lignin,

anthraquinones, salicylic acid which are necessary for the human body. *Aloe vera* works as anti-septic, anti-bacterial, anti-viral, anti carcinogenic and anti-inflammatory (Marshall, 1990; Ahmad *et al.*, 1993). Most herbalists recommend that, they be avoided during pregnancy due to the risk of stimulating uterine contractions and also avoided during lactation due to the risk of excretion in breast milk (Hoffman, 1996). It is because of its high laxative and mucilaginous property in gel.

COMPOSITION

The three structural components of the *aloe vera* pulp are the cell walls, the degenerated organelles and the viscous liquid contained within the cells. These three components of the inner leaf pulp have been reported to be distinctive from each other both in terms of morphology and sugar composition (Figure2). The raw pulp of *aloe vera* contains approximately 98.5% water, while the mucilaginous or gel consists of about 99.5% water with a pH of 4.5 and only 0.5 to 1 % solid material (Boudreau and Beland, 2006). Fresh *aloe vera* leaves used to obtain two components, firstly bitter yellow latex from peripheral bundle sheath of aloe, called *aloe vera* sap and a mucilaginous gel from parenchymatous tissue. Many compounds with diverse structures have been isolated from both the central parenchyma tissue of *aloe vera* leaves and the exudates arising from the cells adjacent to the vascular bundles. The aloe parenchyma tissue or pulp has been shown to contain proteins, lipids, amino acids, vitamins, enzymes, inorganic compounds and small organic compounds in addition to the different carbohydrates (Table 1).

Table1. Summary of the chemical composition of *A. vera* leaf pulp and exudates

Class	Compounds
Anthraquinones/anthrones	Aloe-emodin, aloetic-acid, anthranol, aloin A and B (or collectively known as barbaloin), isobarbaloin, emodin, ester of cinnamic acid
Carbohydrates	Pure mannan, acetylated mannan, acetylated glucomannan, glucogalactomannan, galactan, galactogalacturan, arabinogalactan, galactoglucoarabinomannan, pectic substance, xylan, cellulose
Enzymes	Alkaline phosphatase, amylase, carboxypeptidase, catalase, cyclooxygenase, cyclooxygenase, lipase, oxidase, phosphoenolpyruvate carboxylase, superoxide dismutase
Inorganic compounds	Calcium, chlorine, chromium, copper, iron, magnesium, manganese, potassium, phosphorous, sodium, zinc
Miscellaneous including organic compounds and lipids	Arachidonic acid, γ -linolenic acid, steroids (campesterol, cholesterol, β -sitosterol), triglycerides, triterpenoid, gibberillin, lignins, potassium sorbate, salicylic acid, uric acid
Non-essential and essential amino acids	Alanine, arginine, aspartic acid, glutamic acid, glycine, histidine, hydroxyproline, isoleucine, leucine, lysine, methionine, phenylalanine, proline, threonine, tyrosine, valine
Proteins	Lectins, lectin-like substance
Saccharides	Mannose, glucose, L-rhamnose, aldopentose
Vitamins	B1, B2, B6, C, β -carotene, choline, folic acid, α -tocopherol

(Hamman, 2008)

PROCESSING & THERMAL STABILITY

Aloe vera gel is extracted using cold extraction method and processed into juice as per the method reported by Ramachandra and Srinivasa (2008). Freshly harvested *aloe vera* leaves are dipped into 500 ppm potassium metabisulphite (KMS) solution and washed thoroughly with tap water and kept for flash cooling to 5°C for gel stabilization. The entire process involves washing the *aloe vera* leaves in a suitable bactericide thereafter leaves are cut vertically into two half and gel is separated using stainless steel knife, allowed to settle for 12 hrs and then finally homogenized using mixer grinder and enzymatically treated with 1% pectolytic enzyme at 50°C for 20 minutes. Enzymatic treatment of *aloe vera* gel for a long duration prior to processing is detrimental to biologically active compound such as polysaccharide which is the single most important constituent in *aloe* leaves. Then it is filtered and pH was adjusted to 3.0 by adding citric acid and ascorbic acid to control browning and improve the flavour of *aloe vera* gel juice. Further it is deaerated whose aim to avoid the oxidation of ascorbic acid which eventually improves the shelf life of the *aloe vera* gel juice (Ramachandra and Srinivasa, 2008). After that *aloe vera* juice is pasteurized as like the process of other vegetable juice, this step may affect the taste, appearance and the content of biological activity of *aloe vera* gel product. High temperature short time (HTST) treatment at 85-95°C for 1-2 min. or at 65°C for periods less than 15 minutes is an effective method to avoid the bad flavour and the loss of biological activity of the *aloe vera* gel (Eshun, 2003). After pasteurization, the juice is flash cooled to 5 °C or below within 10-15 sec. This is a crucial step to preserve biological activity of the *aloe vera* gel (Eshun, 2003) and stored. The obtained juice is stored under refrigerated temperature until further use.

HEALTH PROMOTING PROPERTIES

Various researchers reported that the effective components for wound healing may be tannic acid and a type of polysaccharide. Other researchers have also reported anti-inflammatory effects of complex polysaccharides, glycoprotein and sulphated polysaccharides. However, there are many examples in the literature indicating that polysaccharides can exhibit pharmacological and physiological activities without help from other components. It is therefore, logical that the mucilaginous gel of *aloe vera* plant, which is essentially a polysaccharide, holds secrets to *aloe vera's* medicinal properties. Many researchers such as Collin and Collin (1935) have attributed pain-relieving properties to *aloe vera* gel. Hundreds of scientific papers describe activities of *aloe vera* taken internally or applied externally to health promotion. The five unique benefits of *aloe vera* to the body are penetration: *aloe* has the ability to reach deepest body tissues some seven layers deep, antiseptic: *aloe* has at least six antiseptic agents which kill bacteria, viruses and fungi, stimulates cell growth: *aloe* stimulates the birth of new healthy tissue, settles nerves: *aloe* has a clearing effect on the body's nervous system and cleanness: *aloe*

detoxifies and normalizes the body's metabolism. Beyond these beneficial effects of *aloe vera* have many uses in Sprains and Strains, sunburn, scratches, open sores, burns of any degree, lines due to aging, irritations and infections, ulcerated skin lesions, eczema, immune system, cancer, diabetes mellitus, stomach problems, constipation, AIDS/HIV infection, pain suppression, inflammation, cell growth, leukaemia, anaemia.

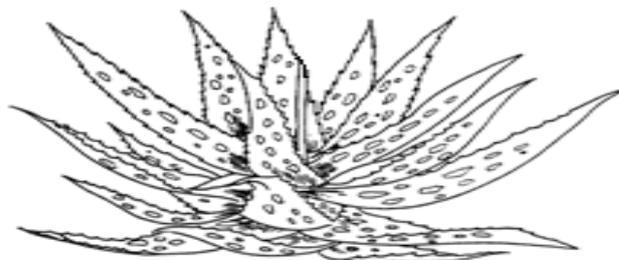


Figure1: *Barbadensis millar*

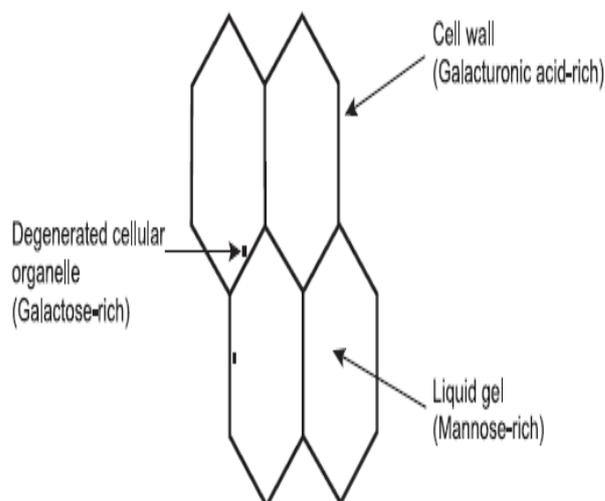


Figure 2: Structural component

ALOE VERA BASED DAIRY/ FOOD PRODUCTS

The *aloe vera* juice finds wide application in dairy/food products like production of ready to serve drink, health drink, soft drink, laxative drink, *aloe vera* lemon juice, sherbet, *aloe* sports drink with electrolyte, diet drink with soluble fibre, hangover drink with B vitamin, amino acids, healthy vegetable juice mix, tropical fruit juice with *aloe vera*, *aloe vera* yoghurts, *aloe vera* mix for whiskey and white bread, cucumber juice with *aloe vera* (Ahlawat and Khatkar, 2011). *Aloe vera* products are available in various forms like capsules, gel and juice. It has cooling effect and bitter in taste, it contains *aloin* that is responsible for its purgative action and well known for its therapeutic properties. It regulates the peristaltic movements of intestines and promotes digestion. Regular

consumption of *aloe vera* juice on a daily basis brings about gradual and gentle health benefits, without irritant or harmful side effects. It also improves blood circulation due to its ability to detoxify. Some notable food products available in the markets are as under.

ALOE VERA HERBAL ICE CREAMS

Aloe vera ice cream prepared with various ingredients to have the final ice cream should contain 10 % fat, 0.5 % stabilizer and emulsifiers, 36 % total solids and 15 % sugar. Various ingredients Viz. milk (buffalo milk), skim milk powder, butter and *aloe vera* added in such a way to obtain the final ice cream should contains minimum of 10 % milk fat and 36 % total solids. The inclusion of *Aloe vera* pulp at 20 % level had maximum score of 92.89. The bitter taste of the *Aloe vera* pulp had masked by the addition of the vanilla flavour and sugar. Process flow chart for the preparation of ice cream samples are shown in figure 3. The production of this dairy herbal ice cream product is beneficial for diabetic patients with natural ingredients.

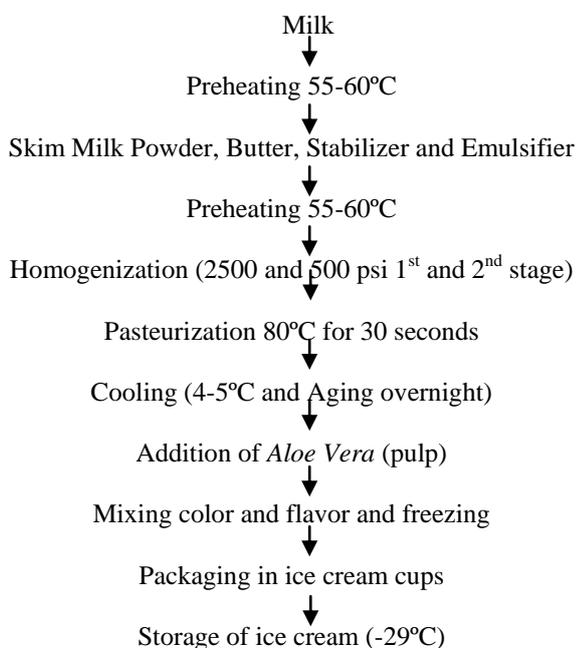


Figure 3: Process flow chart of herbal ice cream (Manoharan *et al.*, 2012)

ALOE VERA CHOCOLATE

The cocoa powder is mixed with skim milk powder. Sugar is dissolved in water till complete saturation in a boiling pan and the mixture is heated with occasional stirring. *Aloe vera* juice is then added to the mixture. Once the mixture attains 110 °C, the cocoa powder and skimmed milk powder are added after then, butter and flavour are added. After 20 minutes the whole mass is oared into a frame on an oiled slab, and then it is cut into appropriate size and wrapped in waxed paper. Maximum sensory analysis of colour, taste, aroma and texture in the *aloe vera* chocolate production is obtained from ingredients at the

optimized process conditions. The optimum condition for taste is sugar 1000 g, skim milk powder 1019 g, cocoa powder 252.5 g and *aloe vera* juice 82.5 ml. (Jayabalan and Karthikeyan, 2012).

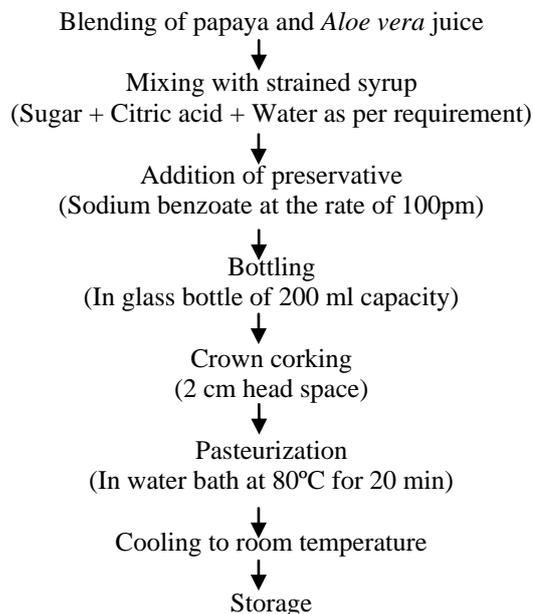


Figure 4: Flowchart for preparation of Papaya and Aloe vera blended RTS beverage

PAPAYA-ALOE VERA READY TO SERVE (RTS) BEVERAGE

The freshly ripe papaya fruits are collected and washed thoroughly in running water. Fruits are peeled with the help of stainless steel knife, cut into two half and seeds were removed manually. The pulp is grind in mixer grinder and filtered through double muslin cloth and enzymatically treated with the 0.65% pectinase enzyme concentration for 230 minute to obtain papaya juice which is stored in refrigerated temperature until further use.

Blended RTS beverages are prepared using 12% TSS, 0.3% acidity and 10% blended juices of blending ratio of 90% papaya juice + 10% *Aloe vera* juice (Boghani *et al.*, 2012) described in figure 4. The RTS beverage with above blending ratio (on the basis of sensorial evaluation) are packed in glass bottles and kept at refrigerated storage temperature. The storage studies revealed that blended papaya *aloe vera* gel could be successfully stored for the period of 3 months without significant in chemical and organoleptic qualities (Boghani *et al.*, 2012).

LOW-FAT SET ALOE VERA FORTIFIED PROBIOTIC YOGHURT

The reconstituted skim milk for low-fat *Aloe vera* fortified set yoghurt was prepared by using 16.57g skim milk powder in *Aloe vera* juice and water blend, 25 and 75 ml respectively. The prepared reconstituted skim milk was heated or pasteurized properly at 82-85°C for 12-15 min. The reconstituted skim milk was cooled to 45°C. Inoculation was done using 3.46% (v/v) of *Streptococcus*

salivarius subsp. *thermophilus* and *Lactobacillus delbrueckii* subsp. *Bulgaricus*, *Lactobacillus acidophilus* and *Bifidobacterium bifidum* cultures, then kept for incubation at 37°C for 8 h. After incubation the samples were kept under refrigerated condition at 4 °C. (Panesar *et.al.*, 2011)

ALOE VERA POWDER

Spray drying is the most common method of producing aloe powder apart from few instances where freeze drying is used (Madan *et al.*, 2009). Dried or concentrated products are definitely less bulky, easier to handle and less susceptible to spoilage in long term storage than those with high moisture, but it is important to ensure that quality is not impaired when applying any of the processing methods. Although any or all of those processing steps can affect the quality and shelf life of *aloe vera* products (Ramachandra and Srinivasa, 2008). Miranda *et al.* (2009) investigated the effect of drying temperature on vitamins C and E in aloe and suggested that their loss can be minimized by drying aloe between 60°C and 70°C. Spray drying is the most common method of producing aloe powder apart from few instances where freeze drying is used (Madan *et al.*, 2009).

Freshly extracted and concentrated *aloe vera* juice containing 87% water (wet basis) was obtained from a commercial processor. The freeze dryer is operated at plate heating temperature 21°C and absolute pressure of 3.3kPa. For better yield of powder, the spray dryer inlet and outlet conditions are adjusted between 170°C to 190°C and 80°C to 90°C, respectively. Refractance window drying involved spreading the aloe extract on a transparent plastic conveyor belt that is heated by hot water. The temperature of the circulating hot water, which provided thermal energy for drying, is in the range of 95 °C to 98 °C, while the average temperature of the aloe is between 60°C and 70°C with the belt moving at a constant speed of 0.1 m/s (Nindo *et al.*, 2010).

ALOE VERA ENRICHED FLAVOUR MILK

Flavoured milk is a beverage in which sugar, flavouring and colouring agents are added and it contains all the constituents of milk. It is a good source of protein, carbohydrate and minerals. It provides energy and water to digest the food, regulate body temperature and prevent dehydration. Jothylingam and Pugazhenthii (2013) prepared the herbal *aloe vera* enriched flavour milk by incorporating *aloe vera* pulp extract at 5 % levels to flavoured milk (figure 5). Further, dietetic herbal (*Aloe vera* enriched) flavoured milk up to 75 % replacement of sugar with aspartame and 100 % replacement of sugar with sucralose are concluded as the best based on the sensory evaluation.

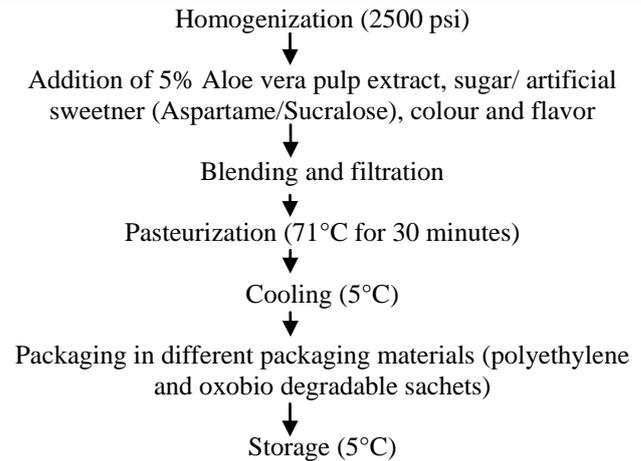
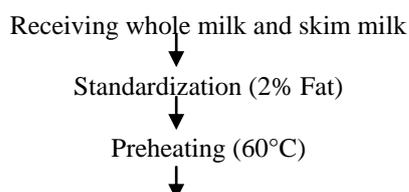


Figure 5: preparation of herbal flavoured milk

THERAPEUTIC READY TO SERVE (RTS) MADE FROM BLEND OF ALOE VERA, AONLA AND GINGER JUICE

Blended therapeutic RTS beverages were prepared using 15% of blended juice extracts of *aloe vera*, *aonla* fruit and ginger, 15% of Total Soluble Solid (TSS) and 0.3% of acidity at the time of preparation in all the formulated blends. The blended juice ratio of *aloe vera*, *aonla* fruit and ginger juices 70:15:15 respectively with 15% of sugar, 0.3% of acidity as % of anhydrous citric acid 50ppm of KMS and 50 ppm of sodium sorbet in one litre of distilled water. Flow chart for preparation of Therapeutic ready to serve (RTS) made from blend of *Aloe vera*, *Aonla* and Ginger juice is shown in figure 6. (Sasi Kumar *et al.*, 2013)

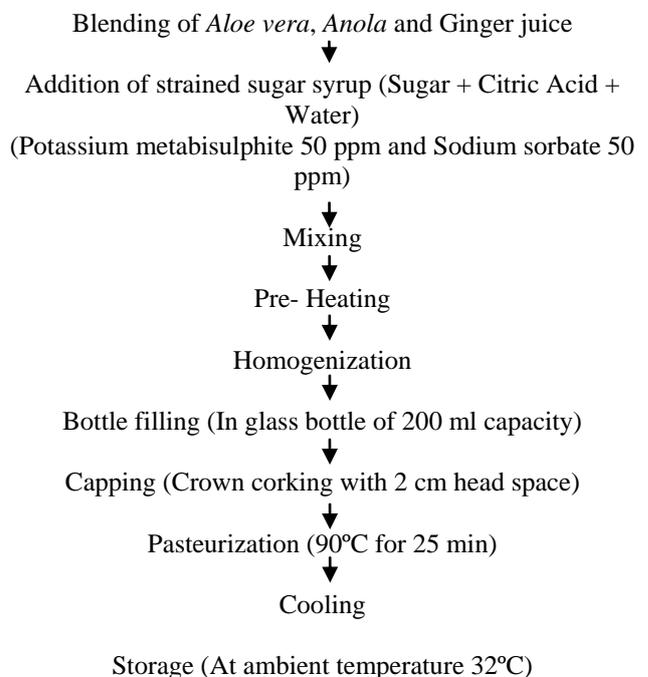


Figure 6: Process flowchart for preparation of therapeutic RTS from *Aloe vera*, *Anola* fruit and Ginger juice based

ALOE GEL ENRICHED DAHI

The milk (fat 3.6%, protein 3.2% and carbohydrate 4.6%) used for preparation of *aloe vera* enriched *dahi*. The homogenized milk was heated at 85-90°C for 5 minutes and cooled to 45 °C. Spray dried *Aloe vera* gel powder was added at 0.15% level and then inoculated with 10% standard *dahi* starter (Hatsun brand, fat 3.1%, protein 3.3% and carbohydrate 4.4%). The inoculated milk was incubated at 45 °C till the *dahi* was set (Ramachandran and Srividya, 2014). *Aloe* gel supplementation in the form of curd to be helpful in lowering the glycemic response to wheat based meal. It further indicates the potential of using *Aloe* gel as a hypoglycaemic ingredient in dairy products. Low glycemic foods incorporated *Aloe* gel nutraceuticals could also result in additional functional benefits.

CONCLUSION

Considering all the updates summarized on different heads above the novel herbal plant *Aloe vera* is a potential component of food beverages, dairy products, processed food besides its medicinal properties especially antibacterial, antifungal and anticarcinogenic properties based on above findings a number of unique products and medicines are being prepared among all it has the highest uses in cosmetic products and raw uses for skin caring. Thus suggested food products based on various studies may further enhance the production and processing of this novel herb

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