

A profile on the aloe industry for export

A focus on South Africa

March 2015

For farmers, investors and traders



agriculture,
forestry & fisheries

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Recognition is given to the assistance and information provided by the various role players in the aloe industry.

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Foreword by the Director-General



As South Africa aspires to a higher growth path, to eradicate poverty and create decent jobs for the future, new creative industries are needed in agriculture, such as industries that can create more value from available resources. Diversity in the business landscape also creates greater economic resilience. These types of industries are more complex and have longer value chains and greater possibilities in meeting various consumer needs. South Africa is a dry country and for the sector to expand, it will require that attention is given to the expansion of crops that are tolerant to drought conditions and optimisation of the jobs created for water used. Furthermore, industries which are less sensitive to phytosanitary requirements are also able to respond faster to global demand owing to easier market access.

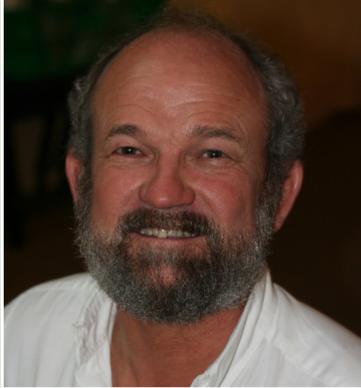
Expanding exports and related investments in the sector will contribute to faster creation of job opportunities. Fast growing new industries are required alongside traditional industries, to meet national growth targets. In this regard, South Africa's foreign offices and trade missions can contribute to local developmental goals when they are able to assist industries to expand their international marketing. This aloe profile additionally contributes to creating awareness and conveys knowledge about this new industry and its potential in the export market.

A handwritten signature in black ink, appearing to read 'Edith Vries', written in a cursive style.

Ms. Edith V. Vries

Director-General: Agriculture, Forestry and Fisheries

Message by the Chairman of The Aloe Council of South Africa



Aloe has been used for thousands of years for its healing and cosmetic properties. South Africa is a focal point of species diversity and Africa is the genetic home for aloe. Even with this available resource South Africa only produces one percent of the world's aloe production for the world market. It is only over the past two decades, that the aloe industry developed into a global multibillion dollar industry. Global demand shows a drastic increase of demand for aloe and other health products as consumers become more aware of the wellness properties of aloe in their diets.

Like all modern industries, the aloe industry's expansion is governed by its ability to keep to high standards that will provide confidence to consumers. Inevitably this requires capital intensive investments. Because the biomedical properties of the plant and product safety are relatively sensitive to the methods of growing, harvesting and processing, the long term growth of the industry is dependent on maintaining high standards. Consumers are paying a premium for health products and its active properties that promote wellness. Consumer confidence is at the heart of a sustainable expanding sector. The Aloe Council of South Africa promotes consumer confidence through its role to facilitate minimum standards and a quality brand. This aloe profile is a first step towards creating a better awareness of the aloe industry amongst potential investors and users of products. The Council also aspires that aloe will become a key South African industry with the support of global marketing efforts.

Prof. Ben-Erik van Wyk

Chairman: Aloe Council of South Africa

Acronyms and abbreviations

AHPA	American Herbal Products Association
AHP	American Herbal Pharmacopoeia
ARP	Aanbevole/Recommended Practice (of the SABS)
BEE	Black Economic Empowerment
CECOSA	Cosmetic Export Council of South Africa
CITES	The Convention on International Trade in Endangered Species of Wild Fauna and Flora
CGMP	current good manufacturing practices
CSIR	Council for Scientific and Industrial Research
DSHEA	Dietary Supplement Health and Education Act (of 1994 of the USA)
DSC	Dietary Supplements Compendium (of the US)
EFSA	European Food Safety Authority
EU	European Union
FDA	Food and Drug Administration (of the US)
FOSHU	Foods for Specified Health Uses (terminology used in Japan)
FSMA	Food Safety Modernization Act (of the American Food and Drug Administration)
GACP	good agricultural and collection practices
GAP	good agricultural practices
GMP	good manufacturing practices
GRAS	generally regarded as safe
HACCP	hazard analysis and critical control points
HFF	“health or functional food” (terminology used in South Korean health food regulations)
IASC	International Aloe Science Council (based in the US)
IMO	Institute of Market Ecology
ISO	International Standards Organization
MCCSA	Medicines Control Council of South Africa
MoH	Ministry of Health (of China)
MPS	mucopolysaccharides
NHP	Natural Health Product Regulation in Canada (that requires prelicensing)
NMR	nuclear magnetic resonance spectroscopy
NOP	National Organic Program (of the US)
OTC	over-the-counter (drug)
PICS	Pharmaceutical Inspection Cooperation Scheme
PPECB	Perishable Products Export Control Board
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals (of the EU)
SANS	South African National Standards
SABS	South African Bureau of Standards
SFDA	State Food and Drug Administration (of China)
USP	United States Pharmacopoeia
UV	ultraviolet
FCE & SID	U.S. FDA Food Canning Establishment (FCE) Registration and Process Filings (SID) certification
TRAFFIC	wildlife trade monitoring network
WHO	World Health Organization

1. INTRODUCTION

This profile on the aloe industry arose from the need to investigate new opportunities for the agricultural sector that could lead growth and exports. For the future, industries are required to manufacture more complex tradable goods, provide multiple high-value product opportunities, provide decent jobs and match the natural resource environment. Aloe was found to suit many of the challenges for future growth.

Aloe has multiple end-user applications such as functional foods, supplements and medicinal applications and cosmetics that make it an ideal crop to create opportunities in value addition. Aloe products therefore have a huge advantage in product beneficiation possibilities and to be exported. South Africa is a dry country and high-value products from cactus plants could be an ideal match for future production expansion. The aloe plant does not make big demands on the environment, can easily be grown organically, requires little maintenance, needs relatively little additional water resources and is tolerant of droughts. Most aloe producers are sensitive to the socio-economic conditions of farm workers and the independent operators such as the tappers. The aloe industry is therefore in a position to take advantage of certification for social accountability and fair trade, for example: the *Fair for life* of the Institute of Market Ecology, the *Fairtrade* label and *FairWild* certifications, for their product marketing efforts.

The primary production of aloe or the harvesting is still relatively easy but value is only unlocked through technological innovation, global marketing and business strategies. Owing to sophisticated global requirements on food and pharmaceutical manufacturing, aloe production requires a substantial capital outlay. Investors and operators are mostly involved in the further value addition and marketing. With raw and intermediary products available in South Africa new investors and entrepreneurs can also manufacture their own formulations and distribute their specific brands.

This profile on aloe provides a broad brush that touches on all the aspects required to successfully farm, manufacture and export aloe raw and intermediary products for global markets. The purpose is awareness and to inform future investors such as farmers, buyers, marketers, product formulators, manufacturers and distributors. The return on investment for trade promotion agencies to promote relatively smaller new industries could have a bigger impact and higher return on investment than assisting conventional larger industries. This is because of the relatively larger contribution a trade promotion organisation can make to smaller new industries to reduce the cost of doing business and lower access barriers to the international markets. The cost of access to relevant business information as well as obtaining international clients still remains high for new industries. South Africa is isolated from the main markets and misconceptions exist that Africa does not have sophisticated manufacturers and suppliers.

The South African government offices globally can assist in opening doors through changing market perceptions of truly South African products that meet world standards. A concerted cooperative effort of the organised industry through the Aloe Council of South Africa can also go a long way towards establishing South Africa as a preferred supplier country of origin for aloe products, especially for those produced organically or from the wild, with fair labour practices and that comply with the highest global standards.

The profile describes the global market environment for aloe products and the opportunities it presents. Further expansion possibilities exist in the general health and wellness fields. A fusion between food and



supplements becomes more apparent as innovative and good-tasting blends come onto the market, often associated with superfood. The increasing number of regulations makes health and medical claims more difficult and necessitates research and development to sustain growth in the health market. The recent growth in aloe health product sales over the past decade is largely spurred by the baby boomer generation that is especially concerned with the rising health-care costs and has resorted to self-medication and healthy living. It is also important to have knowledge of the evolving regulatory environment being essential requirements for all players in the value chain. Production and manufacturing methods and requirements are also discussed and are closely linked to regulatory issues that again impact on both the type of investments and markets. Economic aspects are briefly covered. Most of the known producers and manufacturers are listed at the back of the publication with an explanation of the type of products they produce and an indication of the suitability for international markets. Reading the profile will save new players substantial time in research. It can also be used as a basis for training for marketers to understand some fundamentals of this emerging industry. It also provides a list of the South African suppliers for marketing purposes.

The aloe industry in South Africa is still operating from a low base with a few producers and manufacturers who need all the assistance possible to expand the industry. Agricultural *A. vera* production was only recently introduced in the country in 2008 as a new industry through the foreign direct investment and expertise of AloWay Natural Health Products which has global footprints. A small number of *A. ferox* product companies are based in the Western and Eastern Cape and have made large strides over the past decade to expand into sizable companies. Although *A. ferox* is mainly farmed from the wild, it has the potential to become an organic agriculturally grown crop in the future. With the right kind of local support and the trends in global popularity it would not be unrealistic to envision a tenfold increase in South African aloe production and exports in the next decade. The industry can play its role in the double-digit export growth of “non-traditional crops” and in creating jobs in the next decade.

2. MARKETS AND TRADE

Products from aloe, especially aloe juice and gel, have multiple-use applications, which make it suitable to access various types of market segments: fruit juices, superfruit and functional foods, canning, deserts and in yoghurts, flavourings, various health and wellness supplements, cosmetics, and nutraceutical and pharmaceutical applications. The global market for *A. vera* products is estimated to have reached \$US 13 billion, according to information presented at a recent workshop held by the International Aloe Science Council.¹

One of the most well-known historical benefits of aloe is to enhance skin healing with topical application and as post sunburn treatment. Other uses have proliferated over time, which following the original popularity. According to Datamonitor Consumers' Product Launch Analytics database of new products, *A. vera* has appeared in more than 50 different product categories globally since 2012.² Soap, facial care, and bath and shower products rank as the top three categories using *A. vera* for new products.³ Non-food categories dominate the list, with 18 of the top 20 product categories using *A. vera* as an ingredient, and juices and functional drinks were the only two food categories to reach the top twenty.⁴

Functional food and drinks market

The general wellbeing market segment with a sales value of US\$ 296 billion (2010) over 32 markets researched by © Euromonitor International could be one of the largest promising growth areas for *A. vera* products.⁵ *A. vera* functional food and drinks are often more prominent in Asian markets than western markets. In the general well-



being segment flavoured aloe drinks as functional food could be very popular. If positioned as popular drinks the unacceptable taste can be masked and the aloe can be combined with other functional drinks such as tea and fruit flavours to complement and improve the taste. Often sugar-free offerings or diabetic friendly sweeteners could also be popular because aloe has advantages in regulating blood glucose levels.

Apart from *A. vera* in personal care products as the dominant application, in beverages it attracts the most attention where it is beginning to look like a successor to coconut water, according to DataMonitor.⁶ Coconut water is full of electrolytes such as potassium, magnesium, calcium and phosphorus.⁷ Aloe also has high levels of electrolytes. Increasing attempts is made to move *A. vera* in mainstream use by blends with fruit juices and superfruit juices, water and flavours. One such is AloeGoe⁸ with “Natural Aloe Water” in the US that claims digestive, immune and skin health benefits.⁹ Combinations are also used with other functional ingredients such as ready-to-drink green teas, with various fruit flavours. *A. vera* pieces in drinking yoghurt combined with natural fruit flavours is also a promising product for the future.

Within the health and wellness category, soft drinks were also reported by © Euromonitor International as the most dynamic category that influences growth in sales.¹⁰ *A. vera* can find its growth niche in this trend. According to this report soft drinks comprise 49% of the total health and wellness category and are the main growth determinant.¹¹ Bottled and mineral water is the largest, with a US\$ 8.7 billion growth projection between 2013 and 2018, mainly directed by increased disposable incomes in the emerging markets.¹² The second is juices, especially with a trend to reduced sugar content or added water to reduce sugar levels.¹³ Stevia is more frequently used as flavouring sweetener without calories. Low-sugar alternatives to fruit juices could be gellan gum, a suspension of *A. vera* and fruit pieces retaining viscosity.¹⁴ The most dynamic growth category is ready-to-drink tea with an 18% growth trend but specifically adapted to cultural preferences in various countries.¹⁵ Strategies employed by manufacturers that market ready-to-drink tea, appeal to a wider audience through making a connection with blends of superfoods that is associated with health.¹⁶ Masking of the taste is still a major obstacle for aloe products to become a mainstream ingredient in the general wellbeing segment alongside the popularity of other functional foods such as pomegranate, blueberries and cranberries.¹⁷ African Aloe in Uniondale has a selected range of aloe drinks as refreshing functional food drinks with indigenous fruit blends of marula and apple, and prickly pear and apple.¹⁸ They have maintained a higher-value packaging (glass bottles).

Overall there seems to be a tendency to more healthy products and in many cases some fusion between functional foods and supplements and the various categories: water, juices, smoothies and teas. Uses in the food market still set a price ceiling on the prices that consumers are prepared to pay but it also opens a broader higher-volume market compared to health supplements. However, the divide between good-tasting functional foods, good tasting chewable and drinkable supplements and traditional supplements presentations is blurring as consumers get weary of swallowing multiple tablets and capsules on a daily basis. The trend continues as Hippocrates suggested long ago: “Let food be thy medicine and medicine be thy food.”

Traditional and new health supplement uses

One of the most popular uses of pure aloe juice from the inner leaf gel is for internal use as a dietary supplement, either as capsules or juice, where taste is less of an issue to health-minded consumers. The high polysaccharide content together with over two hundred beneficial natural components is regarded as a major support for general health, for example: immunity enhancement, dietary track health, urinary track health, cardio-vascular health improvements, and anti-inflammatory properties. Polysaccharides are regarded as a key ingredient to orchestrate other components to reduce inflammation, enhance the general healing ability of the body and skin, and keep the dietary track regular and healthy because of the improved prebiotic activity. These functionalities are all used in marketing positioning to expand the market share of the products.

Success in the supplement market is for example seen in Hong Kong where Vita Green Health Products Co Ltd leads the domestic market with a value share of 47% through its Doctor's Choice *A. vera* brand.¹⁹ Key global players in the juice as dietary supplement are Herbalife and Forever Living Products International Inc.²⁰ Often the success also lies in the type of marketing strategies applied; through branding, network marketing and direct sales strategies or *via* internet or through health-shop outlets that provide unique propositions to selected and targeted client groups. Improved product formulation also has a role to play

to expand the market to make the taste acceptable for the general consumer. Forever Living Products has added various flavours to their juices to make it more palatable; such as the Aloe Berry Nectar, a combination of *A. vera* gel, cranberry and apple juice sweetened with fructose; and the Forever Aloe Bits N' Peaches, *A. vera* gel pieces with peach flavour.²¹ African Aloe in Uniondale has a health drink with *A. ferox* juice blended with Acerola berry extract.²² The company Aloe Ferox also has whole-leaf supplements where the natural favour is masked through an orange taste as well as mint and caramel flavours.²³

The global "beauty from within" markets doubled over the period 2005 to 2010 and were found to be the second most dynamic category by © Euromonitor International's health and wellness research of 32 markets.²⁴ These offerings typically target consumers who desire a youthful skin, often combined with other functional ingredients such as collagen and enzyme Q10 for skin elasticity, added vitamins, and functionalities for anti-aging, anti-inflammation and detox benefits.²⁵

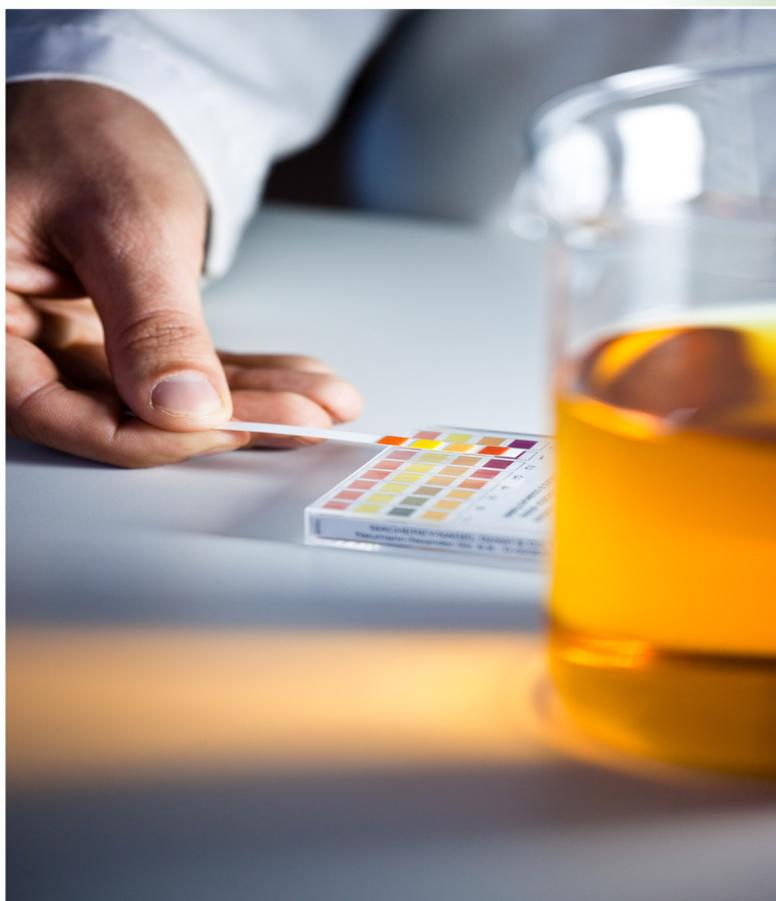
Aloe products could also penetrate the digestive health market. This market is worth US\$ 63,2 billion across 32 markets with immune support valued at about US\$2,4 billion with a 45% growth according to © EuroMonitor International.²⁶ The digestive health products are dominated by pre- and probiotics.²⁷ Aloe that is correctly processed and preserved is high in polysaccharides; complex and long soluble fibre sugar chains that aid digestive health. Probiotics are microorganisms like lactobacilli that aid nutrient absorption in the stomach. Prebiotic is non-digestible fibre like polysaccharides that passes through the digestive track and aid the growth of the advantageous stomach bacteria. Probiotics are reported to assist with resistance against flue and common cold systems and play a role in the stress response of the body and could aid general mental health.²⁸ An interesting link was found between probiotics and the moods of mice. The effects of the probiotics applied to mice were similar to mice that received antidepressant drugs.^{29 30} Other research also showed that probiotics can improve the moods of patients.³¹ Inulin or oligo-fructose is another example of polysaccharides and it is obtained from the chicory root. Scientists discovered that these prebiotics aid the absorption of calcium and magnesium in the body and a 23% increase in absorption were observed in women that took prebiotic's.³² Prebiotics also played a role in reducing the risk in colon cancer. The benefit of aloe is that it contains both high calcium and magnesium as well has prebiotic activity if the manufactured product was correctly processed and preserved. © Euromonitor International reported countries with a high growth of probiotic sales in 2011 were:

the United States;
South Africa;
Israel; and
China.³³

Other dynamic markets suitable for aloe positioning are the oral health market worth US\$16,7 million at a growth rate of 39% and the urinary tract market worth US\$146 million over the period 2005 to 2010.³⁴

Cosmetics and toiletries

A large part of the aloe products is focused on the cosmetic market. Some reports³⁵ assume that 10% of most cosmetic products contain *A. vera* gel but other calculations such as by the International Science Council used a more conservative figure of around 2%. Most cosmetic ranges contain various percentages of aloe in skin care products. Although competition in the skin-care market could be high, the profit margins on cosmet-



ics could also be relative high. Aloesin, for example, found in the aloe bitters blocks the formulation of melanin in the skin. It is popular in Asia as a skin lightening agent and was found to prevent oxidase activities.³⁶

© Euromonitor International reported healthy growth in cosmetics and toiletries, specifically hair-care products among the South African black population.³⁷ According to the report a growth increase of 47% from 2001 to 2005 and a further 5% to 2010 was reported to be directed by the rising disposable income of the black population that have exceeded that of the white population.³⁸ Further, the majority of the hair-care sales (43%) in South Africa came from the black population that wants deep conditioning products for special hair-care needs.³⁹

Trade statistics on aloe

The table below shows selected historic market sizes for aloe supplements (the basic aloe juice and topical skin ingredient), at retail value in US\$ million at current prices fixed on 2013 exchange rates.

Geographies	2008	2009	2010	2011	2012	2013
Hong Kong, China	0,3	0,3	0,3	0,3	0,3	0,3
South Korea	131,6	126,3	127,0	130,8	138,6	148,3
Bulgaria	0,4	0,4	0,4	0,5	0,6	0,7
Czech Republic	0,6	0,6	0,6	0,6	0,6	0,6
Hungary	10,4	10,8	11,3	11,8	12,6	13,3
Slovakia	1,4	1,4	1,4	1,4	1,5	1,5
Chile	2,3	2,1	1,7	1,8	1,9	2,1
Mexico	42,6	37,6	35,1	33,3	35,2	37,2
Peru	0,3	0,3	0,3	0,3	0,3	0,3
US	55,9	57,8	61,1	69,6	81,1	95,8
Greece	1,9	1,8	1,7	1,7	1,6	1,6
Italy	78,8	87,9	93,3	97,1	99,0	100,6
Portugal	1,0	1,0	0,9	0,9	0,9	0,9

Research Sources – Consumer Health: © Euromonitor International from trade sources/national statistics (Date exported (GMT): 21/07/2014 12:42:13)

© Euromonitor International reported the trade in aloe to the value of about US\$ 403 million to 13 countries. These selective markets and products account for only less than half billion US\$ of the total US\$ 13 billion aloe global market as recently calculated by the International Science Council.⁴⁰ Aloe supplements had a healthy growth in many of the main markets researched by © Euromonitor International⁴¹ and some of the growing market trends are as follows:

- The aloe supplement market in the US almost doubled in the country from US\$ 55,9 million in 2008 to US\$ 95,8 million in 2013. About half of this market was dominated by Forever Living Products International, LLC and Lily of the Desert Organic Aloeceuticals.
- In South Korea aloe supplement sales have grown from a high base of US\$ 131,6 in 2008 to US\$ 148,3 in 2013. More than 90% of the sales were dominated by three companies: Herbalife Ltd, Univera Inc. and Aloe Maiim Co.
- In Italy aloe supplements have grown from US\$ 78,8 million in 2008 to US\$ 100,6 million in 2013. In Italy about 90% of the aloe supplement sales are dominated by six companies: Aboca SpA, Specchiasol SpA, Herbalife Ltd, Docteur Nature Srl, Menarini Group, and Equilibra Srl.
- In Hungary more than 80% of the aloe sales were dominated by six companies: Forever Living Products International LLC, Herbalife Ltd, Oriental Herbs Kft, and Ökonet-Európa Kft, Lily of the Desert Organic Aloeceuticals, Alveola Kft and Laboratoria Natyry Sp zoo.

3. REGULATORY ENVIRONMENT FOR MARKET ACCESS

The international regulatory environment for aloe products is complex with multiple layers of compliance that apply for various categories of end products from aloe. Country-specific standards increased over the

past decade. The many mandatory country and buyer requirements necessitate modern factory conditions for successful supply to international markets. Fairly large and sophisticated operations are required to successfully focus on exports owing to the volumes that would be economically viable. Batches of products usually have to be tested before these can be distributed on the market and be used as ingredients. Modern practices require minimum facility standards and the administration burden is relatively heavy.

South African national standard for aloe raw materials

The Aloe Council of South Africa was founded in 2006 with the aim, among others, to promote the setting of standards for the industry and to deal with mutual issues for the promotion of the industry. Standards go a long way towards improving the credibility of the industry for sustained growth in international markets. Standards South Africa (the former SABS) developed SANS 368:2008; a minimum *National Standard for Aloe Raw Materials*.⁴² The standard specifies the requirements and test methods especially with *A. ferox* raw material in mind, although many of the guidelines can apply to any aloe species because it focuses on safety standards.

The SANS standard deals with:

- General requirements such as declaration of adulteration of raw material by adding chemicals as well as harvester hygiene requirements.
- Harvesting requirements of the aloe plants for tapping the bitters, such as leaf size, plant size and recommended harvesting intensity.
- Specified details such as a minimum aloin content of 18% for export purposes of the bitters and manufacturing of pharmaceutical preparations from bitters.
- Various requirements on microbiological limits for various test methods and materials such as raw materials, bitters and aloe gel for various uses.
- Details on test methods and calculation methods for microbiological counts and heavy metals.
- Packaging guidelines and specifications as well as labelling transparency requirements such as the specified polysaccharide content.

The SANS standard is, however, not extensive enough as a standard for the export of *A. vera* products. The American Herbal Pharmacopoeia (AHP) has the most detailed independent monograph on *A. vera* raw and intermediary products.⁴³ However, many provisions of this monograph are specifically written for *A. vera*, and therefore do not apply to specifications for *A. ferox*.

Good agricultural and collection practices

Internationally various guides exist on good agricultural and collection practices (GACPs) for collecting herbs and medicinal plants from nature. These practices are specifically of importance for hygiene; to minimise the microbiological load owing to possible contamination during growing, harvesting, drying, packing and storage. For organic products steam treatment and good harvesting practices, are the only methods to reduce the microbiological load contamination without adulterating the medicinal and functional properties of the ingredients.⁴⁴ For those reasons best practice is required for sustainable and responsible harvesting and total quality control. The FairWild Foundation based in Switzerland with its secretariat hosted at TRAFFIC international in the UK, has also developed guidelines on sustainable wild resource management called the FairWild Standard. The FairWild Standard is specifically for sustainable management of wild harvested plants and the trading thereof in a manner that also benefits rural producers. Targeted consumers are willing to pay a premium price for products featuring this trademark.

Several guides exist on good harvesting and collection practices:

- The ARP 029: 2013 (Ed. 1.00) from Standards South Africa (former SABS) contains a *Guideline for Good Agricultural and Collection Practices*.⁴⁵
- The PPECB audits and certifies good agricultural practises (SA GAP).

- The Botanical Raw Materials Committee of the American Herbal Products Association (AHPA) in cooperation with the AHP has published a guide on *Good agricultural and collection practice for herbal raw materials*.⁴⁶
- The World Health Organization (WHO) has in 2003 published guidelines on *Good agricultural and collection practices (GACP) for medicinal plants*.⁴⁷
- Some standards and certifications concentrate more on a combination of socio-economic responsibility and broad sustainable and responsible harvesting and environmental standards, such as:
 - *The FairWild Standard* focuses on sustainable harvesting management practices and socio-economic responsible trading.⁴⁸
 - *Fair for life* of the Institute of Market Ecology requires ethical worker conditions across the entire supply chain as well as adherence to strict environmental standards.⁴⁹

GRAS recognition

Products have to be generally regarded as safe (GRAS) for the intended use to be allowed on the market and be consumed as food products, functional foods or supplements. Countries normally publish their database of products that are regarded as GRAS.

Hazard analysis and critical control points

Hazard analysis and critical control points (HACCP) is a minimum food safety requirement to manage food safety. It generally supports good manufacturing principles. The South African standard from the SABS SANS 10049 provides general guidance and SANS 10330 provides specific HACCP standards that can be certified and are auditable. HACCP is a general food safety standard for the systematic prevention of hazards in food production processes. HACCP is a basic desirable standard for the food processing industry.

In South Africa HACCP is still a voluntary standard for the food industry. HACCP regulations on food are governed by the Foodstuffs, Cosmetics and Disinfectants Act 1972 (Act No 54 of 1972) of the South African law. Although it is mostly a voluntary standard for foodstuffs, the Minister can list mandatory requirements for some industries. The Act acknowledges the Standards Programme of the Codex Alimentarius Commission's general requirements on food hygiene, entitled: "*Hazard Analysis and Critical Control Point (HACCP) System and Guidelines for its Application*", as the main guide as published in the Supplement to Volume 113-1997 document of the commission. However, according to the Act equivalent HACCP systems are also recognised.

HACCP determines a system that would also make possible the recalling of faulty products and identification and elimination of hazards in the manufacturing process. In this regard the United States has passed a Food Safety Modernization Act (FSMA) in 2011 that gives the FDA the right to recall orders and requires access to companies' safety records.

To meet these requirements would necessitate numerous HACCP controls. The FDA has specific guidelines for HACCP compliance.⁵⁰ The principles of HACCP are fairly universal, but specific guidelines are sometimes developed for specific industries.

Good manufacturing practices

Good manufacturing practices (GMP) mostly apply as mandatory standard for products with health and medicinal

Modern factory conditions according to good manufacturing practices

Source: AloWay Natural Health Products



claims but could also be voluntarily applied by food manufacturers. The WHO has developed a GMP that is widely used by especially developing country regulators to standardise biological and biotherapeutic materials, to guide and regulate the production and control of biological products and technologies used especially for medicinal uses.⁵¹ In South Africa, new amendments to the Medicinal Act empower the Medicines Control Council (MCC) to issue licences to manufacture medicines. The Act will also regulate health claims on any product to ensure that it is fit for the intended use and that claims are backed up by evidence. Many aloe producers are also getting ready for the full implementation of regulations by 2019. The South African GMP Guide is based on the “Guide to Good Manufacturing Practice for Medicinal Products”: published by the Pharmaceutical Inspection Cooperation Scheme (PICS).⁵² There are currently several participating countries, including Australia, Canada, United Kingdom and the European Union.⁵³

The amendments to the Medicines Act have therefore expanded the scope of the Act to control both the medicine and the process and environment within which it is manufactured. The GMP guidelines are enforceable as law in South Africa.⁵⁴ The Health Products Association, an industry body for complementary medicine also supports businesses involved in complementary health products.⁵⁵

Current good manufacturing practices (Cgmps) in the US is published on the website of the FDA and deals with the practice in manufacturing, packaging, labelling, or holding operations for dietary supplements.⁵⁶⁵⁷ The final 2007 rule is presented on the Federal Register.⁵⁸ In the US it is not required to prove that supplements are safe or effective as long as health claims are not made. In the US preregistration of food and supplements are therefore not a condition for imports. In Canada preregistration and a site licence are required of any manufacturing site, packers, labellers and importers of health products.⁵⁹ In the US there are no specified GMP requirements for non-drug cosmetics but only for drug-based cosmetics.⁶⁰ Exporters of food and supplements to the US also have to register their facilities under the Bioterrorism Act that requires registration of facilities and includes notification procedures for shipments.⁶¹ GMP regulations specify that a company may not release a natural ingredient for production in a batch if the ingredient has not been tested and found to be within specifications.

Pharmacopeia of monographs

Usually ingredients have to conform to specifications on the relevant monograph to be regarded as pharmacopoeia grade.⁶² Canada has a compendium of monographs available from Health Canada.⁶³ The United States Pharmacopeia (USP) has developed a Dietary Supplements Compendium (DSC) with a few hundred official monographs that covers quality aspects; identity and content testing of materials, microbiological testing, chemistry, strength, purity and manufacturing controls.⁶⁴ The 8th Edition of the European Pharmacopoeia published in July 2013 is currently in force and contains more than 2 220 monographs. These monographs describe both the individual and general quality standards for ingredients, dosage forms and methods of analysis for medicines as well as the ingredients.⁶⁵ On the website of the European Commission are various regulations pertaining to food supplements with regard to lists of permitted ingredients, safety and labelling.⁶⁶ In South Korea edible aloe is regulated as food product by the Korean Food and Drug Administration.⁶⁷



International standards for the *A. vera* industry

The America's *International Science Council* has determined standards for *A. vera* L. or or sometimes incorrectly referred to as *Aloe barbadensis* Miller. They determined that only products containing acemannan (a type of polysaccharide or glucomannan) can truly be labelled as *A. vera*, which means "true aloe" and specifically refers to *Aloe vera* L.⁶⁸ This is to identify if the content contains *A. vera*. The argument on the use of the name is disputable but nevertheless it is a standard for identifying *A. vera* as commonly understood. This standard does not hold for polysaccharides from the *A. ferox* plant, which does not have acemannan as a marker, but does contain higher levels of other types of polysaccharides. Another generally accepted industry safety standard determined from the Cosmetic Ingredient Review Expert Panel is that aloe gel for topical use should contain less than 50 parts per million aloin.⁶⁹ According to the report *A. vera* gel, as well as low anthraquinone (latex or bitters) whole leaf extract, is safe for topical use. For oral use the aloin should be less than 10ppm although aloin levels in most *A. vera* liquid gel products are less than 1 ppm, except for whole leaf extracts which may be higher.⁷⁰

The American Herbal Pharmacopoeia (AHP) has the most detailed monograph on *A. vera* raw intermediary products. Findings are supported by the International Aloe Science Council (IASC) and set an independent standard for *A. vera* juices. These include the minimum safety standard for aloin content, and the required polysaccharide content. It provides a guide for quality control and testing to ensure the integrity of certified *A. vera* products. These standards are the most comprehensive standards yet for good manufacturing practices of the *A. vera* inner leaf gel.⁷¹ *A. vera* leaf juice is included as a priority on the United States Pharmacopoeia convention, but still pending.⁷² According to the Health Canada's ingredient monograph, aloe latex (bitters) can be used for topical application for minor burns and minor wounds.⁷³

The anthraquinones (latex or bitters) has proven to possess anti-bacterial and antiviral properties. In some topical gels formulations in countries like South Africa, where there is a historic cultural use, especially from local species such as *A. ferox*, deliberately may have added higher-level formulations for antiseptic use. World standards on low anthraquinone levels (aloe bitters) or elimination of it are based on the absence of enough toxicology proofs that all components in the anthraquinones are safe for general use. This is a serious threat to a multibillion dollar industry and therefore explains the virtual exclusion of anthraquinones as a key safety standard in aloe gel products. In Africa, especially with traditional medicinal uses, aloe products without bitters can barely sell because the bitters resemble the medicinal value. Aloesin, a component that can be extracted from the anthraquinones or latex, is used as modulator to prevent melanin formation to lighten skin. Aloesin also is known to scavenge free radicals, is anti-inflammatory and provides UV protection. Preliminary tests on mice have shown that Aloesin is not toxic. Further clinical research is required. Too little is known yet about the healing properties and toxicology of components in latex and the industry was built on traditional uses and personal testimonies.

North American regulations

Aloe and its products were already approved as food additives by the US FDA as early as 1959. In the US aloe latex (bitters) can be used in food supplement formulations with laxative claims but after 2002 it was no longer approved as an over-the-counter (OTC) drug for chronic constipation.⁷⁴ The aloe latex (mostly anthraquinones with abundant aloin) lost its GRAS status, because the industry could not provide safety data at the time. The pure, dried latex (bitter yellow sap) is therefore regarded by the US Pharmacopoeia as a medicinal drug (Aloe Rx) with strong cleansing effects.⁷⁵ In South Africa and generally in Africa it is also frequently used for its strong laxative effects as well as its detoxification benefits. Standard quality tests for aloe latex are described in the various Pharmacopoeia of the US, Europe and Japan. In the US it is not required to prove that supplements are safe or effective as long as health claims are not made. However, in Canada it is necessary to preregister supplements before they come onto the market.

The International Trade Centre has undertaken a relatively detailed study on natural products for the North American markets with elaboration on regulatory requirements.⁷⁶ The report identified that certifications for fair trade and organic are an area of high market growth. This trend was confirmed from visits to the aloe industry in South Africa.

The Dietary Supplement Health and Education Act of 1994 (DSHEA) provide the regulatory framework for dietary supplements in the US, where dietary supplements are regarded as a special category of food.

Therefore in the US supplements have to meet the criteria of food that is GRAS. Dietary supplement regulations are available from the FDA.⁷⁷ Canada's natural health product (NHP) regulation requires precertification. For products destined for Canada, the manufacturing sites must comply with GMP requirements.⁷⁸ In Canada health products also have to have a licence as listed on the Licensed Natural Health Products Database.⁷⁹ This requirement could make it difficult for complex products that do not have an established traditional use. Generally functional foods that have an additional health benefit beyond normal nutrition have to comply with the same standards as for food products and little distinction is made from a requirement perspective. With new creative products the line between health supplements and functional foods is increasingly becoming blurred.

In the US cosmetics are regulated by the Federal Food, Drug and Cosmetic Act⁸⁰ as well as the Fair Packaging and Labelling Act⁸¹. Health Canada prescribes regulations pertaining to cosmetics as well.⁸²

European regulations

Basic legislation on food hygiene was adopted in April 2004 by the European Parliament and the Council and became applicable in 2006.⁸³ The hygiene regulation covers the legislation on production, processing, distribution of food products for human consumption.

Ingredients that have been chemically modified need to be registered according to the European Union (EU) legislation (June 2007) on Registration, Evaluation, Authorization and Restriction of Chemicals (REACH).⁸⁴ Such products also require a material data sheet. The interpretation of REACH by the International Aloe Science Council provides some guidance.^{85 86}

EU legislation is restrictive on health claims for aloe products. The Nutrition and Health Claims Regulation (2006) regulates food and supplements.⁸⁷ According to the regulations a list of health product claims were evaluated by the European Food Safety Authority (EFSA) and as a result little if any claims can be made except on some vitamins and minerals.⁸⁸ EFSA requires substantiation of health claims at the level of drug claims.⁸⁹ As a result health claims are difficult in the EU and rely heavily on general consumer perceptions.

In Europe aloe can be used as flavouring agent in food and drinks with a maximum aloe content of 0,1 ppm (Regulation EC 1334/2008). However, this regulation was initially written for flavours not originating from whole aloe products. It is questionable if it applies to aloe food and drinks. The Cosmetics Directive of the European Union describes the use of cosmetics and personal care products with regard to Aloe.⁹⁰ Both *A. vera* and *A. ferox* can be used as feed additives in the EU according to Regulation No 1831/2003.⁹¹

Asian regulations

In China food safety is regulated by the Food Safety Law of 2009 and the Chinese Novel Food Regulation (or New Resource Food) of 2008.⁹² Novel food is food that was not traditionally in the Chinese diet.⁹³ The regulations attempt to reduce complex approval, stimulate research and development and variety, but still have strict rules on food safety. A novel food that does not have a history of use in China requires regulatory approval by the Ministry of Health (MoH) and an approval process on the quality and safety of the food.⁹⁴ The regulations cover the description, safety assessment, approval process, production management and hygienic inspection of novel foods in China.⁹⁵ In China health foods and novel foods are differently regulated. Health food requires pre-market authorisation from the State Food and Drug Administration (SFDA) to substantiate safety and health claims. Approved health claims can be made on health foods but are not for purposes of treating diseases or making medical claims, but only for general health. Health foods are limited to two claims per product and exclude claims on curing cancer and claims to improve sexual improvement.⁹⁶

In South Korea, "health or functional foods" (HFFs) can be on a generic approved list that is exempt from premarket approval. New ingredients must undergo evaluation to substantiate claims on safety, standardisation and efficiency of the product to be evaluated by the Korean Food and Drug Administration.⁹⁷ New foods are regulated by the Novel Foods Regulations of 2010 and by the Food and Drug Administration. Edible aloe concentrate or gel containing a minimum of 30 mg/g aloe polysaccharides can make a claim of "smoothing the evacuation" as well as edible aloe with 2 to 50 mg anthraquinones (aloe bitters) which

can make the same claim.⁹⁸ *A. vera* can also allegedly enhance the immune system and such claims are allowed to be made in South Korea.

Japan first developed the “functional foods” concept, also called “health foods”.⁹⁹ Aloe can be used as components or ingredients of functional foods or Foods for Specified Health Uses (FOSHU). Such uses can relate to health promotion and controlling conditions such as cholesterol or reducing health risks. In Japan *A. vera* juice may not contain more than 0,60 mg/kg benzoic acid.¹⁰⁰

4. PRIMARY PRODUCTION AND HARVESTING

About 400 aloe plant species is known. Only two species are discussed in this profile: *A. vera* (*A. barbadensis* Miller) and *A. ferox*. Twenty-two aloe species are listed in CITES Appendix I as endangered.¹⁰¹ The rest of the species are listed in Appendix II as less endangered and automatic permits apply to monitor trade and make periodic assessments. *A. vera* (*A. barbadensis* Miller) is excluded from CITES and not regarded as endangered. Only *A. vera* is commercially grown globally on a large scale for its inner leaf gel. *A. ferox* is mainly harvested from the wild for its bitters. *A. ferox* is indigenous to South Africa. The latter also has potential to be grown agriculturally or be propagated in the wild for harvesting. *A. ferox* is limited to niche markets within the aloe market and claims could, for instance, be made that it is harvested from the wild in a responsible and sustainable manner. On the other hand, the popularity of *A. vera* as agricultural crop is the result of its high yield on aloe juice, good response to fertiliser and irrigation, relatively low bitter (latex) content, easier processing and it is easy to grow organically with little natural pests occurring. The most medical research has also been done on *A. vera* and it is widely known in the world. *A. vera* originates most likely from North Africa and prefers a subtropical and relatively dry and frost-free climate.

A. vera cultivation

A. vera is the main species that is globally cultivated agriculturally because it yields the largest volume of inner leaf gel juice. Normally *A. vera* is reproduced from offshoots from the mother plant. Such offshoots could be removed twice a year. For commercial production, the identity of the plants has to be established before cultivation. Aloe species can also very easily hybridise and this could be an issue when multiple species are cultivated. The *A. vera* plant lasts about 8 years of commercial cultivation after which it becomes too top heavy and will topple over; then it needs to be replanted. The plant can be harvested from year two and would be a mature plant in year three.



A. vera plant, South Africa

Source: AloWay Natural Health Products



Organically grown *A. vera* in Vivo, South. Global labour best practices are followed.

Source: AloWay Natural Health Products

Three leaves (more or less) can be harvested at a time from a mature plant. Even though much more leaves can be harvested at any one time, plant growth can be stunted. If plants are harvested a few leaves at a time, then three harvesting cycles in a year are possible. The older lower leaves are carefully removed in a way that does not damage the rind. A damaged rind could make the gel susceptible to bacterial contamination and oxidation. A mature leaf weights about 700 g to 1 kg and just a little less than half the weight could be economically extracted as inner leaf gel. Normally *A. vera* is not grown for the bitter latex as the *A. ferox* is more suitable for that. However, if plants are water stressed they do produce more latex. Although aloe is very drought resistant, *A. vera* requires small volumes of regular irrigation of about 150 mm per month (40 mm per week) or at least 2 to 4 litres per plant per week throughout the dry months to give commercial yields of the gel. Too dry conditions will increase the latex (yellow bitters) content, which will give an unfavourable taste and colour for gel production.

A standard recommended spacing is about 1m rows and about 60 cm spacing between plants.^{102 103} This gives a plant density of about 15 000 plants per hectare, but taking into account access roads it could be around 10 000 to 12 000 plants per hectare in practice. Small animals like sheep can be used to graze between the plants for weed control. If assumed that a plant from year two gives on average 12 kg of leaves per annum, then 1 ha will yield approximately 110 to 120 tons of leaves. A hectare can yield about 25 000 to 35 000 litre single strength juice per annum.¹⁰⁴ However, with optimal production practices a mature plant can give double the quantity to about 22 to 24 kg of leaves per annum.¹⁰⁵ AloWay Natural Health Products in South Africa has presently a capacity of around one to two million litres of single strength juice per annum, with some expansion possibilities in the near future. In practice various strengths are produced by concentrating the juice.

Conditional to the ideal climate, aloes are relatively resistant to pests and require little maintenance. The outer rind and layer of bitter sap prevents insect damage. This makes it ideal for growing organically. Most aloes are sensitive to freezing temperatures, especially *A. vera* because of the high water content (98,5%) in the leaf. Aloe species can also not withstand waterlogging and need well-drained alkaline soils and a relatively dry, hot climate (less than 500 mm rainfall) with supplemental evenly spread irrigation.

A. vera is grown in subtropical zones such as: Mexico, the Dominican Republic, Texas in the United States, Guatemala, Costa Rica, Venezuela, Argentina, Brazil, India, Southern China, Thailand, Malaysia, Australia, Spain, Greece, Pakistan, the Middle East and Africa. In South Africa suitable areas could be frost-free micro-climates in the Limpopo and along the West Coast. Fertilisers can be applied but organic fertilisers are preferred and better absorbed by the plant. Higher organic content in the soil is preferred to maintain biological soil activity.

Some indications could be found that the world's primary production of *A. vera* was around 19 000 ha and worth over \$100 million in 2004.¹⁰⁶ With value addition and growth over the past decade the total industry was calculated to be worth about US\$ 13 billion in 2012.¹⁰⁷ In 2004 the potential forecast to expand was almost tenfold, mostly from Mexico, the Dominican Republic and China.¹⁰⁸ The South African industry also has the potential to substantially expand from the present low base; on condition that export markets are found and the industry remains to be competitive.

A. ferox cultivation and harvesting

Little commercial cultivation of *A. ferox* exists except for a few hectares of experimental plantings in the Albertinia area. Dr M. Muller previously calculated that aloe farming can be more lucrative than grain farming in the long run. It is, however a slow-growing plant. Further research has to be done on the economic viability of farming *A. ferox*. *A. ferox* is still mostly harvested from the wild and mainly for its latex (yellow





Experimental *A. ferox* plantation in Albertinia

Source: Mr Chris Pattinson, Organic Aloe



A. ferox plants in the wild at Uniondale

Source: Hendriette du Plessis, African Aloe



A. ferox leaves packed in a circle to drain the bitters

An *A. ferox* tapper tapping aloe bitters in the wild in Uniondale

Source: Ms Hendriette du Plessis, African Aloe

bitter sap), a high-value raw product. Relatively small quantities of the gel are processed, compared to the total volumes of leaves harvested for cosmetics and drinking supplements. Most of the leaves remain in the field after harvesting the bitter sap. Potential exists to process larger quantities of the inner leaf gel for food and supplement products if it can be economically harvested and processed. Newton and Vaughan estimated that in the 1990s the leaves of approximately 10 million plants were harvested to produce about 400 ton of *A. ferox* bitters per annum.¹⁰⁹ Most of the raw products are exported to Germany, the UK, Italy and Japan.¹¹⁰ Only about three rows of leaves (15 – 20 leaves per plant weighing 0,6 kg each) can be harvested from a plant every 12 to 18 months. This equates to about 90 000 ton leaves per annum. After tapping the bitters, most of the leaves are returned to the soil and some are processed for gel and whole-leaf products.

The experimental cultivation of *A. ferox* takes place at a plant spacing of about 10 000 plants per hectare. Little or no maintenance is required after establishment of the plants. The plants, grown from seed, reach maturity (flowering) in four to six years¹¹¹ and will be fully grown in seven to eight years, depending on growing conditions. The industry (SANS) criteria standard requires that a plant has to be at least 0,5 m in height before it is harvested. Aloe species were found with over a 150 years lifespan.¹¹² *A. ferox* normally propagates by seed in nature and it takes about 5 weeks to germinate. Small seedlings can be replanted. It also can be propagated by cutting the head of a mature plant, letting it lie for 2 weeks to dry and then replanting it to develop roots over six months. If intercropping is considered with other natural herbs such as *Sutherlandia* and *Buchu* it could possibly be cultivated with a higher gross margin and a shorter break-even point. Plant material and land are the main cost factors in extensive farming as there is little other maintenance required. Potentially all the parts of the leaf can be used; the latex (bitters) for medicinal applications and the gel and whole leaf for supplements and drinks as well as the gel fillets. Dried aloe leaf is also considered a feed supplement with beneficial use as natural antibiotic and growth stimulant for animals.

Harvesting of the bitters is usually done by independent harvesters or tappers who are assigned to farms. A recent initiative by Cape Nature has organised a tappers cooperative to enable better coordination and better bargaining power as a collective. Harvesting of the bitters is usually done on a profit-sharing basis

with the farmer. Tappers are aware of best practices (sustainable harvesting) and their income depends on the sustainability of the industry. They are also learning the basic rules of respecting nature. The plants should have at least 20 leaves and be 0,5 m in height before they have enough resilience to be harvested. Older plants require at least 12 to 16 remaining leaves after harvesting to ensure that they can survive droughts, colds spells and diseases. Bottom leaves are cut about 3 to 4 cm away from the stem to ensure that the leaves seal properly and infection does not affect the plant. Only about 2 to 3 rows of leaves (approximately 15-20 leaves weighing 0,6 kg each) are harvested from one plant every 18 months. Plants that are harvested before the flowering stage do not develop flowers. The cut leaves are stacked into a circle to drain the bitters at the cut ends. In the middle of the circle, bitters are accumulated as it drains into a hole in the ground that is covered with plastic. Normally harvesting does not take place on windy days or if it is too cold or during severe droughts when the plants display a red colour. A red colour is a sign of water stress. Some plants are left unharvested to propagate seeds. The bitter sap is then collected in drums and further processed into aloe lump or aloe dried powder.

CITES permits and wild harvesting

Unlike many other aloe species, *A. vera* is not enlisted as endangered on CITES and is globally grown agriculturally without restrictions. This makes unrestricted trade relatively easy and free from environmental permits. Users and governments' perceptions on trade in goods that are on the CITES list of endangered species and that are regulated by permits could possibly present an unnecessary barrier, like in the case of *A. ferox* or Cape Aloe. For example, small consignments of highly processed products that have minute percentages of aloe content need permits that are cumbersome and costly in terms of time and administration. Although *A. ferox* is not presently endangered, automatic permits allow the Department of Environmental Affairs to monitor its trade volume. *A. ferox* has been sustainably harvested in a responsible manner for decades. However, there are reports that have alerted to isolated cases of unsustainable harvesting practices in the Eastern Cape. Mature aloe plants are also removed from nature and sold for ornamental purposes. Owing to its wide availability in nature *A. ferox* is not regarded as endangered in any of the provinces in South Africa yet, although the situation is being monitored.

A. ferox may in the near future become an agriculturally grown crop, which will secure its abundance. Preliminary indications are that it can become a profitable crop that can be grown extensively in an organic and natural manner with no or little chemical interventions. Some farmers may want to populate it in a natural way and to some extent this is already being done. It is a slow-growing plant and breakeven point could take more than a decade, unless it is combined with other high-value herbs, for example Buchu and Sutherlandia. An economic viability analysis has not been done yet. However, the present genetic biodiversity is valuable as a world heritage and worth maintaining. The aloe bitters from which medicinal substances are extracted varies in both aloin and aloesin contents based mainly on plant genetics and not on geography as initially suspected. This makes broader cultivation of *A. ferox* for its bitters possible outside of its natural habitat. *A. ferox* is already artificially propagated outside South Africa. In Europe it is mainly cultivated as an ornamental plant.¹¹³

Bio-prospecting licences

The Bio-prospecting, Access and Benefit-sharing Regulatory Framework¹¹⁴ aims at preserving indigenous knowledge and to share the benefits of income from production with the community from which the intellectual property right originated from. A permit fee (R5 800) per annum in 2014 is payable. Reports are frequently received from industry holders that the present manner in which the permit is applied to the *A. ferox* industry could unfortunately stifle entrepreneurship and the development of the industry. In the permit application there is no exemption in terms of the size of the operation which will exclude smaller role players. According to reports in some cases the entire supply chain is expected to pay for permits. At present, the income from the permits does not return to the industry. Also there is no identifiable community to which the "intellectual property rights" belongs. For decades aloe was used by a very widely dispersed community in South Africa. The present-day tappers have a definite role, however, this role is confined to the knowledge of tapping bitters in a traditional and sustainable way. Broader product innovations like the use of the gel in drinks imitate global knowledge and applications of *A. vera* over ages and are not specifically connected to indigenous knowledge. It is most likely that *A. ferox* can become an agriculturally grown crop

in the near future and some regard environmental regulations as an unnecessary constraint. In other cases it may provide an entry barrier to protect existing aloe businesses. Closer cooperation is needed between departments to ensure that indigenous species can be economically commercialised to the benefit of the country and that several layers of legislative compliances do not constrain sustainable commercial growth.

5. PROCESSING

Basic components of the aloe leaf are: the aloe rind or outer green skin, the inner leaf fillet or gel that contains no bitters, and the yellow bitter sap (aloin) that occurs between the rind and the gel fillet. Basic intermediary products from the aloe are:

- Products from the aloe whole leaf: juice, dried powder, or dried pieces for food and tea
- The inner leaf gel in the form of a juice or fillet pieces with no bitter content,
- The bitter sap or Aloin
- *A. ferox* also has high levels of pectin.

The whole-leaf products are typically used as health supplements and pharmaceutical formulations and capsules. The inner leaf gel can be used as health supplements, functional juice blends, and taken in pure liquid form or be used in skin product formulations. The bitters is used for various health applications such as detoxification, constipation, and components of the bitters (like aloesin) are used as skin lightening agent, to prevent sunburn and scavenging free radicals. This is not an exhaustive list of the uses but only a summary of the main uses of the basic aloe ingredients.

Aloe products usually fetch a premium price owing to health claims as functional food, health supplements or cosmetics with health or beauty functions. As a result it is important to handle and process aloe in such a way as to optimise and stabilise the biomedical properties. Careless processing in any step of the manufacturing could easily destroy the functional properties. Credibility in the industry is the basis of sustained growth. It is important for investors in the marketing, distribution, product formulations and manufacturing to familiarise themselves with the key principles of quality products that normally accompany modern GMP.

In *A. vera* processing the quality of the polysaccharides is especially important as a key compound that facilitates healing, or provides a health function that exceeds that of ordinary food, also so-called functional foods. Although polysaccharide is regarded as a main bioactive compound that can be tested, it is believed that more than about 200 components in aloe have complex synergetic and enhancing actions for maintaining general health. Davis, for example, has formulated the conductor-orchestra concept that gives a new basis for the use of aloe for general health and wellness.¹¹⁵ For these reasons the processing and standards for aloe are of key importance to the industry in marketing and end-use formulations.

Inner leaf juice processing

A summary of the processing of *A. vera* provides insight into the important aspects of GMP. The publication by Ramachandra, C.T. and Rao, P.S. (2008) on *Processing of Aloe Vera Leaf Gel: A Review* provides a detailed overview as well as the article by Plaskett, G. on *Aloe Vera, The Crucial Importance of Correct Processing*.^{116 117} Management control of the harvesting and production process is critical for successful manufacturing of aloe products. The basic first products, each requiring its own process flow is: the dried leaves for tea or supplements, the inner leaf juice of single strength or inner leaf gel fillets, and the whole leaf extract. For the *A. ferox*, the first product to be recovered would be the Aloin or aloe latex (bitters). Aloin can also be converted into aloesin according to a CSIR patent (number WO 2006/097811 A1).¹¹⁸ Normally the latex is not recovered from *A. vera* but just washed away. For the purpose of this literature study the focus will be on the inner leaf gel or fillet, however, the above studies also make mention of the correct whole-leaf processing. Whole-leaf processing requires additional grinding of the leaves and removing of the bitters through prior washing or charcoal filtration.

The first critical step in manufacturing is during harvesting. *A. vera* leaves should be undamaged and matured (3-4 years) to keep active ingredients in full concentration.¹¹⁹ *A. vera* leaves can be removed without cutting to prevent bacterial contamination. Leaves of *A. ferox* are normally cut to first extract the latex and



Washing of the *A. vera* leaves before processing

Source: AloWay Natural Health Products

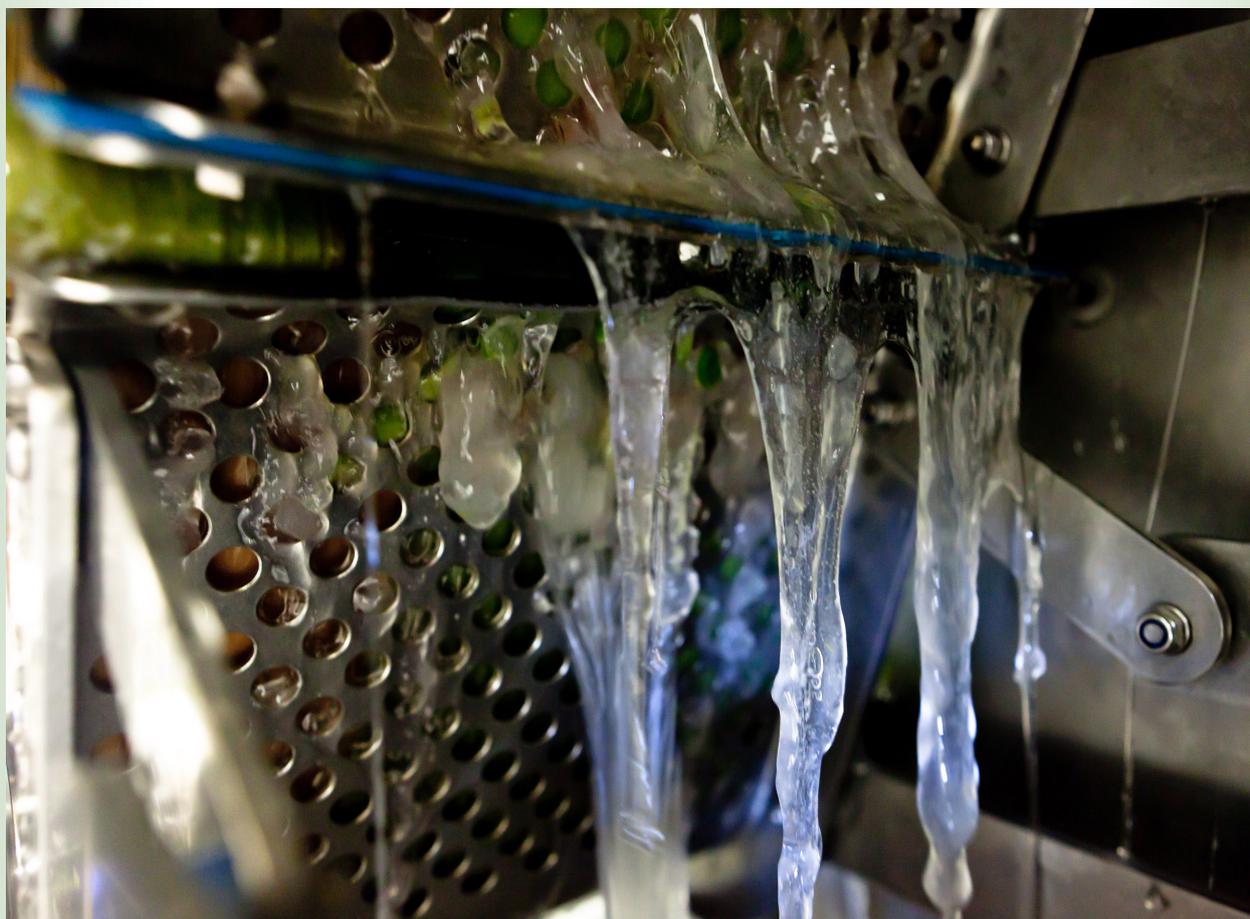
the last of the latex seals the cut in the leaf. The moment the *A. vera* leaves are harvested the natural plant ingredients start deteriorating owing to continued enzyme activities and breakdown of valuable properties. Oxidation happens with cutting and bacterial infection may also occur, and this has to be prevented or minimised. After 24 hours the bioactivity in *A. vera* can reach zero if left unprocessed.¹²⁰ At AloWay Natural Health Products in South Africa, the leaves are normally processed within two hours of harvesting to preserve the maximum bioactivity. For longer time spans it is important to place the plant material in cold storage as soon as it is harvested, but still to process it under six hours.¹²¹ The timing requirement has an influence on the distance the primary production site should be to the manufacturing plant. Processing time to stabilise the product is crucial to the quality of the product, especially for retaining the long chain-complex sugars or polysaccharides as well as over a 100 beneficial bioactive components known in aloe.

Before the gel is extracted, the leaves are drained and washed from all latex (yellow bitters). In *A. vera* this is done by cutting the leaves at the ends and sides and letting the latex drain, and then the remaining latex is washed away. In *A. ferox* the leaves are cut into pieces and washed in warm water. If care is taken in the production process, almost all the latex can be removed from *A. ferox* leaves without any carbon filtering process. Normally a food grade disinfectant could be used in the water in the washing process to contain bacterial activity. The inner gel of *A. vera* is pressed out of the leaves by machine and pulped or could be hand or machine filleted and then pulped. In *A. vera* the gel is already in a liquid because of its high water content. The soluble solids in the *A. vera* gel are only 0,5% percent, the rest is water. Citric acid is also commonly used in *A. vera* gel to improve the taste and in preserving. The gel can be flash cooled immediately after extracting the gel to preserve biological activity.¹²²

A. ferox inner leaf gel cannot be pressed out of the rind or outer leaf like with *A. vera* gel. *A. ferox* leaves can be washed and milled or hand filleted, and milled, depending on the product to be produced. The milled leaves are pressed and juice is then processed into powder through alcohol extraction. The pressed leaves can be dried or processed further through a patented method to release the gel. South African patent ZA 941581 deals with extracting polysaccharides from the inner leaf gel of *A. ferox*. Citric acid plays a role in attracting the salts like potash and magnesium that will release the gel. Alternative methods may exist.

The further process described mainly applies to *A. vera* processing as found in the reviewed literature. Similar processes could be followed for *A. ferox* gel manufacturing although it requires additional steps to leach the salts and release the gel. A monograph does not exist yet on producing and identifying quality *A. ferox* gel with a high content of polysaccharides. *A. ferox* leaves for gel production are normally left much longer before being processed because the latex (bitters) is harvested first. It is not certain what the effect of time is on the quality of the polysaccharides of the leaves and other biological components in the *A. ferox* gel. It could be that degradation of the leaves is much slower because of much thicker cell wall structures and a much higher pectin content of the gel. This has a benefit in producing a large quantity of high-quality pectin but with a much less recoverable aloe gel powder component. Although it is likely that biological activity of *A. ferox* is contained longer in the gel, studies have not confirmed yet the best manufacturing practices for *A. ferox* gel in terms of the effect of timing before processing. The *A. vera* production is used as guide because of the availability of best practice process descriptions in the literature.

The next step after extracting the *A. vera* gel and cooling it down, is to stabilise the gel immediately to stop the enzyme and oxidation process and stop any potential bacterial or fungal activity. An enzyme could be added, like cellulase to further break down the cellulose to release the cell content. The product is systematically preserved by various optional preservatives, for example potassium sorbate, sodium benzoate, citric acid and could be combined with vitamin E.¹²³ Care should be taken because too much and too long enzyme activity can reduce the various polysaccharides or complex sugar chains to basic or smaller sugar molecules and this will destroy biological activity and the benefits of polysaccharides. The product could also be simultaneously heat treated with the enzymes for less than 15 minutes at 65 °C to assist in cell breakdown and pasteurisation. Alternatively, it can be enzyme treated at 50 °C for 20 minutes without loss in biological activity.¹²⁴ Various recipes exist. The gel can also be pasteurised for 1 to 2 minutes at 85 to 95 °C and then flash cooled to below 5 °C in 10 to 15 minutes.¹²⁵ Maximum stability of polysaccharides



A clear juice is expressed from the *A. vera* leaves in the first step of processing

Source: AloWay Natural Health Products, South Africa



A clear, pure golden-coloured single-strength *A. vera* juice is obtained after treatments and stabilising, filtering and preserving the juice to maintain optimal bioactivity

Source: AloWay Natural Health Products



A. vera factory in Vivo, South Africa

Source: AloWay Natural Health Products, MD: Mr. Piet Viljoen

has been reported at 70 °C. Longer exposure to heat can substantially reduce biochemical activity and the process needs to be controlled. Pasteurization is necessary to prevent organism growth that is activated by the presence of oxygen in the gel. Cold-processing techniques frequently use enzymes such as glucose oxidase and catalase to inhibit the growth of organisms.¹²⁶ The product is continually turned in the storage tanks probably to optimise suspension of soluble content and optimise preservation. The product is usually filtered to remove unwanted and insoluble solids to obtain a clear product that can remain stable for many months. Humidity and temperature are important environmental parameters that may affect the storage life of the product.¹²⁷

After a single strength product has been obtained it can be further concentrated through evaporation or trio-osmosis. A first concentration can be done under vacuum without loss of biological activity under 125 mm mercury vacuum at below 50 °C in less than 2 minutes.¹²⁸ With evaporation through heat exchange, the heat level is a factor that may adversely affect the quality, and the process should be controlled. Modest

Final *A. vera* bulk product supplies: concentrates, fillets and powder

Source: AloWay Natural Health Products



levels of concentration are recommended, because salts will also increase with increasing concentration, which may affect biological activity and the formation of new reactions that may alter the polysaccharide molecules.¹²⁹ Spray-drying is sometimes done to reduce the weight of the intermediate product in order to lower transport costs. However, spray-drying can greatly further reduce the bio-active ingredients owing to the application of further heat. It also usually requires a processing aid such as maltodextrin to be added.¹³⁰ Although freeze drying is the most effective method to retain maximum biological activity, it is relatively expensive.

Overall the sophistication of the production process, the ability to follow GMP as well as product quality monitoring abilities and recalling abilities have an important effect on the quality that can be guaranteed. The highest therapeutic value *A. vera* gel is obtained from products that contain 10 000 and 20 000 mucopolysaccharides (MPS).¹³¹ High-quality *A. vera* juice has about 1 200 mg/l Alverose polysaccharides and in a 1:10 concentrate it goes up to 12 000 mg/l and the aloe powder could have about 40% Alverose polysaccharides.¹³² The benefit from buying direct from producers is that the factory procedures could be verified as well as the quality of the product could be certified.

Inner-leaf fillet processing

For a more basic operation a high-quality dried fillet can be obtained that could skip many of the complicated processes. This process involves air drying of the fillets at the optimal temperature and humidity. The aloe inner-leaf fillets or cubes of *A. vera* can be dried and powdered. Whole-leaf cut pieces can also be dried (as seen in *A. ferox* products) for supplements or tea. When the fillet is dried gradually the product retains the macromolecules because cell wall structures are not broken down. The final powder would also not contain any preservatives. The rehydration of the gel powder would come back to its natural slippery form. Simal *et al.* reported optimal levels of three functional properties studied in *A. vera* gel at a subtle drying temperature of 40 °C and a significant modification of polysaccharides at higher than 60 °C drying temperatures.¹³³ Nevertheless, Miranda *et al.* found minor alterations in the structural properties and total polysaccharide content at drying temperatures between 60 and 70 °C that still provided a high-quality gel.¹³⁴ Lower temperature quick-drying methods are most suitable for superior products, such as the Omatrix process of Aloecorp. Kim *et al.* 2009 reported a novel drying process that retains 20 to 30% more polysaccharides in his publication: *A Novel Method for Air Drying Aloe Leaf Slices by Covering with Filter Papers as a Shrink-proof Layer.*¹³⁵ The filter prevents the outer layer to dry quickly. This allows inner fluids from evaporating gradually and evenly. In this manner a better cell structure is retained in the drying process. The process is regarded as a more economical alternative to freeze-drying. The dried powder is ideal for functional food drinks that require fibre and gel like properties.



AloWay Natural Health Products in Vivo as well as African Aloe in Uniondale also produces fresh aloe cubes. AloWay Natural Health Products has recently acquired advanced processing technology for volume filleting of *A. vera* that is able to fillet 800 kg of leaves or process 1,5 metric tons (Mt) cubes per hour.¹³⁶ Cubes can be preserved for various uses such as canned fruit cubes or in yoghurts or drinks. Jams can also be made of the fillet cubes. For fresh products pasteurisation and preservation would have to be sufficient for storage. The *A. vera* can be stored in airtight containers with nitrogen and a preservative, imbedded in its own juice.



Illustration of the peeler and dicing machines at AloWay Natural Health Products.

Source: Frontier Market Network.¹³⁷



Raw material: Aloe lump (top), bitter powder (left), Lump grinded powder (right)

Source: Organic Aloe

Production of *A. ferox* bitters

The bitter sap is collected in drums from the field. Modern processes reduce the moisture content under controlled conditions and the liquid is then spray dried. Organic Aloe in Albertinia provides a spray dried product. The historical method that is still applied is to boil the bitter sap in drums fuelled with fire to produce lump or also called crystals that are then grinded to pieces or a powder. The bitters are also called Aloin. Aloesin is a component of the aloe bitters. Aloin can also be converted into Aleosin according to a CSIR patent (number WO 2006/097811 A1).¹³⁸ Aloesin is a high-value product used for skin lightening, especially by Asians. It is also used to

prevent sunburn and for its free radical scavenging properties. The raw product is still exported, although a growing degree of value addition takes place before exports. Aloe bitters is traditionally used as laxative and/or small quantities are used to stimulate appetite.

Whole-leaf dried products

Whole-leaf *A. ferox* is washed to remove all bitters. The leaves are cut into pieces and allowed to sundry under hygienic conditions. GACP are followed from harvesting to final processing to minimise the bacterial

count to acceptable levels. This is necessary for organic products because no other methods are available except steam sterilisation to keep bacterial counts to acceptable levels and retain all the biological activity in the whole leaf. The dried leaf is grinded and used in supplements and tea.



Cut pieces of *A. ferox* leaf for processing
Source: Mr Chris Pattinson, Organic Aloe



Alcohol distillation plant for producing *A. ferox* inner leaf gel
Source: Mr Chris Pattinson, Organic Aloe



Spray dryer for spray drying aloe bitters

Source: Mr Chris Pattinson, Organic Aloe

6. PROCESS FLOW, ECONOMICS AND PRICES

A feasibility study would go beyond the purpose of this document, but it is important to have an appreciation of the process, processing equipment and product prices. From *A. vera* basically only the gel is harvested that becomes a single strength juice, as well as fillets in various cuts and dices. For *A. ferox* a typical factory may have several production lines for drying and grinding the whole leaf for tea and supplements, evaporating and spray drying the latex (bitters) and gel, and extracting the gel through alcohol extraction and pectin through a heating process.

The basics of *A. vera* gel processing will be discussed to get an appreciation of the process flow and equipment required. Leaves are received and first washed in soak tanks to wash the outer dirt from the leaves. Leaves can be hand brushed to further clean and inspect the leaves or a mechanical cleaning can be done through high-pressure jets. Leaves are then cut at the sides and ends by hand to bleed all the latex bitters. The leaves are then again washed in water tanks with a food grade sanitiser.

After removing all latex the leaves can be pressed by machine to remove the inner-leaf gel from the outer rind. Pressing out the gel by machine is typically done for producing the aloe juice from the inner-leaf gel. The liquid is then pulped and pumped by a diaphragm pump into a jacketed tank. The tank can be heated or cooled down or pressure can be applied. According to the process described in the processing chapter, the product is then stabilised and pasteurised. While the product is heated it is also stirred and enzymes are added to dissolve the cell walls. Preservatives are also added. The purpose of this stage is to immediately stabilise the bioactivity in the gel and preserve most of the medicinal properties. After stabilisation the gels is then press filtered to remove all insoluble fibre and impurities and are ready to be stored in large stainless steel tanks. The single strength gel can be evaporated by heat exchange or by ultrafiltration or trio-osmosis machine. A further option exists, namely to spray dry the product to a powder.

Recognition is given to Mr Piet Viljoen from AloWay Natural Health Products for providing guidance on some of the information that follows.

An alternative processing route for the leaves is to fillet them by a filleted machine or by hand to make gel pieces or dices. The drained weight of the cubes is 45% to 90%. At AloWay Natural Health Products dices

are typically shipped in 25 litre drums that are airtight and sealed. Dices are preserved in their juice with ascorbic acid added. The drums are sealed with added nitrogen to replace any oxygen. The market is typically in Asia where aloe is well known and consumed. Markets in Germany want frozen fillets.

Price indicators of aloe intermediary products on the world markets:

- Concentrated (1:10) juice fetches about US\$ 12 to 13/kg or US\$ 12 000 to 13 000/ ton.
- 1:100 Powders fetch about US\$ 130 to 180/kg or US\$ 130 000 to 180 000/ton
- Raw aloe fillet dices/cubes sell for US\$ 630 to US\$ 1 000 /ton overseas but locally could sell for about around R4 200 a ton.

Transport costs from African destinations are still very high and are a major factor in pricing and competitiveness for exports.

The typical cost items of an aloe production facility

- Land and establishment costs
- Factory building, offices and laboratory space and equipment.

Machinery and equipment:

- Soak and rinse tanks
- Inspection and separation table
- Grinder (mincer) for the whole-leaf product
- Pulping machine (gel separator)
- Diaphragm pump
- Jacket tank/s (holding vessel) that controls temperature and pressure
- Press filters
- Cooling unit
- Stainless steel tanks (3 000 to 4 000 litre capacity)
- Evaporator or ultrafiltration or triosmosis machine
- Spray dryer
- Installation costs
- Peeling machine
- Dicer machine
- Powder-filling machines
- Capsule-filling machine.

Other costs:

- Office equipment
- Vehicles
- Human resources
- Utilities
- Processing costs
- Labour and housing
- Transport.

The machinery alone can cost over R2 million. Generally a full-scale primary production unit like that of AloWay Natural Health Products or Organic Aloe could cost up to R30 million, which includes the cost of the land, factory, labour and housing costs, and irrigation. Such operation can create about 70 new jobs for 30 to 50 ha, which is less than a R1 million per job created. Given substantial growth prospects for the industry it still can create a substantial number of new jobs over the next decade at double digit growth rates. Smaller outgrower units are possible within a certain radius of the manufacturing base. The internal rate of return could be double digit figures but is heavily dependent on the ability to find and sustain lucrative markets.

Bitters

The bitters still remains the most economic viable product to be harvested from *A. ferox*. Small but growing quantities of the whole leaf as well as the gel are produced, sold and exported but mainly in final products.

The total bitters production in South Africa is in the order of about 300 to 400 tons per annum. The industry from natural harvesting can probably still grow tenfold with growth in the global demand based on the discovery of new uses and applications. Audits of the natural sustainability are still being done. However, the industry will reach a limit where it has to artificially plant *A. ferox*.

The bitters market prices increased substantially over the past months from R45/kg to R75/kg (2014). Tappers get up to R65/kg to provide the bitters sap in a “crystal” form. A small percentage of leaves harvested is utilised, the rest goes back into the soil. Only 10 to 20 ml of bitters are harvested from a normal 600 g leaf. An average plant can give about 80 ml sap a year and a hectare of 8 000 to 10 000 plants can give around 720 kg yield of bitters a year that is equal to around 324 kg in lump or 309 kg of lump powder. If a retail price of R55/kg for lump and R60/kg for lump powder is assumed, the bitters from a hectare would give a gross sales income of around R17 820 per annum for the lump and R18 570 for the lump powder for the value added raw material. This is only a scenario and further work has to be done to establish the layout costs, the gross margin and breakeven point for farming with *A. ferox* for its bitters.

If it is cooked and excess water evaporated, then 2.3 kg bitter sap forms 1 kg cooked bitters. The aloin content of aloe in the Albertinia/Western Cape region is from 23% to over 30%, while the Eastern Cape has a much lower aloin percentage, as low as 5%. Attempts were made by the University of Stellenbosch to enable the aloe for certain characteristics. The aloin content is linked to plant genetics and not to geography. However, bitters content increases in dry conditions and decreases in wetter conditions. Aloesin can also be produced from the aloin. One kilogram aloesin sells for about US\$ 1600 to 1800. A market exists in East-Asia for aloesin for skin lightening products. A high capital layout is needed to manufacture the aloesin. The CSIR has a patent to produce aloesin.

7. PROFILES OF KEY PLAYERS AND CONTACT DETAILS

7.1 *A. vera* raw material producers

7.1.1 COMPANY NAME: ALOWAY NATURAL HEALTH PRODUCTS



AloWay Natural Health Products is at present the only *A. vera* producers in South Africa and also has a factory in Curacao Island

Website	http://www.aloway.com
Contact address	Iphofolo Game Farm, P.O. Box 45, Vivo 0924, Limpopo Province, South Africa Tel.: +27 (0) 786216834 E-mail: info@alowayafrica.com
Marketing and sales office	Building 8, Highveld Technopark, 48 Oak Avenue, Centurion, South Africa. Tel.: +27 (012) 665 0503 E-mail: info@alowayafrica.com
Sales and distributor offices	Europe, Africa and Asia (see website)

CERTIFICATIONS, BEST PRACTICES, MEMBERSHIPS

- Application of GMP principles and batch certification (product batches undergo independent NMR spectroscopy analysis by recognised German laboratories)
- Certified NOP, Eco-cert, Kosher and Halal
- IMO Fair for Life certification was still in process by August 2014
- Member and contributor to the Aloe Council of SA.

PRODUCTS

AloWay Natural Health Products is a world-class agricultural producer and manufacturer of a range of *A. vera* raw materials. Products are grown agriculturally and are organically certified.

The full product range is available on <http://www.aloway.com/products/> and in summary consists of:

- Raw materials
 - Liquids: 1:1 and 1:10 concentrates and infusions
 - Powders: 1:100 and 1:200 spray dried powder
 - Solids: pulp and dices in various sizes
- Bulk formulations
 - A range of personal care
 - Animal care
- Finished products
 - Nutraceutical supplements.

RAW MATERIAL CAPACITY

A million litre pure aloe juice (2014)

EXPORT GEOGRAPHICAL COMPLIANCE CAPACITY GLOBALLY

US, Canada, Europe, Asia and the Middle East, Latin America.

7.2 A. ferox raw material producers

7.2.1 COMPANY NAME: AFRICAN ALOE



Website	http://www.africanaloe.com and www.natureshealth.co.za
Contact address	Intermediary raw products factory supplies African Aloe (Pty) Ltd 1 Show Street, Uniondale 6460, South Africa Tel.: +27 (0)44 752 1588 Fax: +27 (0)44 752 1493 Mobile: +27 (0)82 781 0376 Tel.: +27 (0)44-7521494 Henriette cell: +27 (0)72 5041135 E-mail: info@africanaloe.com E-mail: andre@africanaloe.com

CERTIFICATIONS, BEST PRACTICES, MEMBERSHIPS

- GMP practices
- HACCP - SANS 1033:2007 (SABS)
- Kosher certification (PAREV)
- Certified by the Institute for Market Ecology in Switzerland (EU), (IMO), for its Organic Wild Production and Processing of Organic A. ferox Products, EU and NOP certification number: 110467
- Integrated CITES Export and Bioprospecting permit (Permit no.: IEP 0009)
- Registered with the U.S. FDA (Registration no: 17391113456)
- Health products registered with the Medicines Control Council of South Africa (MCCSA).
- Member and contributor to the Aloe Council of South Africa.

PRODUCTS

African Aloe based in Uniondale South Africa produces both intermediary raw products as well as a range of final products from organically wild harvested *A. ferox* plants. A range of products is available on their websites <http://www.africanaloe.com/> and www.natureshealth.co.za

Intermediate manufactured products:

- Aloe inner fillets and cubes and gel
- Aloe bitters
- Aloe juices; supplements and functional-food drinks
- Aloe whole leaf-powder
- *A. ferox* extract

RAW MATERIAL CAPACITY

Unknown

EXPORT GEOGRAPHICAL COMPLIANCE CAPACITY

US, Europe

7.2.2 COMPANY NAME: BIO-SOLVE

Website	http://www.bio-solve.co.za
Contact address	Derick Johannes Cell: +27 (0)83 793 4898 Tel.: +27 (0)21 974 6139 Fax: +27 (0)21 974 6101 E-mail: derick@bio-solve.co.za or info@bio-solve.co.za

CERTIFICATIONS, BEST PRACTICES, MEMBERSHIPS

Aloesin production according to patent number WO 2006/097811 A1, granted to the CSIR: Method for converting aloeresin to aloesin

PRODUCTS

Aloesin

RAW MATERIAL CAPACITY

50 to 100 (kg per month)

7.2.3 COMPANY NAME: ORGANIC ALOE



Website	http://www.organicaloe.co.za
Contact address	P.O. Box 199, Albertinia 6695 Tel./fax: +27 (0)28 735 1557 Sales and Marketing South Africa Magda Nesor Mobile: +27 (0)83 305 3111 magda@organicaloe.co.za Head Office and Factory admin@organicaloe.co.za chris@organicaloe.co.za

CERTIFICATIONS, BEST PRACTICES, MEMBERSHIPS

- GMP principles in manufacturing processes and recording the origin of raw materials through batch allocation
- CITES and bio-prospecting permits
- Member and contributor to the Aloe Council of SA
- US FDA Registration (Registration number 15926816402)
- US FCE & SID certification.

PRODUCTS

Organic Aloe mainly focuses on the processing of *A. ferox* raw materials wild harvested from nature. The full product range is available on <http://www.organicaloe.co.za/index.php/our-product/product-range-overview>

- Gel powder 1:200
- Bitter fraction cooked or spray dried
- Various qualities of juices and gel
- Various qualities of aloe fibre and tea.

RAW AND VALUE ADDED MATERIAL CAPACITY

500 tons p.a.

EXPORT GEOGRAPHICAL COMPLIANCE CAPACITY

Europe and the US

7.2.4 COMPANY NAME: KALOES

Contact address	Mr Ken Dodds Tel.: +27 (0)44 7521266 E-mail: aloes@netactive.co.za
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CERTIFICATIONS, BEST PRACTICES, MEMBERSHIPS

- Organic certification – Ecocert
- Member and contributor to the Aloe Council of SA

PRODUCTS

- Aloe bitters
- Aloe leaf powder
- Aloe fillets
- Aloe gel
- Plant material.

RAW MATERIAL CAPACITY

Unknown

7.2.5 COMPANY NAME: SCHIBUNA ALOE CC

Website	http://www.schibuna-aloe.co.za
Contact address	P.O. Box 24, Kommadagga 5800 Tel.: +27 (0)42 235 1530 Fax: +27 (0)42 235 1500 E-mail: sales@africancures.co.za

CERTIFICATIONS

BEE

PRODUCTS

- Aloe lump (low aloin content)
- Aloe lump (high aloin content)
- Aloe powder (low aloin content)
- Aloe powder (high aloin content)
- Aloe granules (low aloin content)
- Aloe granules (high aloin content).

7.3 Aloe final product producers

7.3.1 COMPANY NAME: HOUSE OF ALOES (ALCARE)

Website	http://www.aloe.co.za
Contact address	Postal address P.O. Box 278, Albertinia 6695, South Africa
	Physical address 39 Industrial Road, Albertinia Tel.: +27 (0)28 735 1454 Fax: +27 (0)28 735 1728



CERTIFICATIONS, BEST PRACTICES, MEMBERSHIPS

- CITES and Bio-prospecting permits
- Member and contributor to the Aloe Council of SA

PRODUCTS

Alcare produce a range of final consumer products on health and supplements and skin care. Natural ingredients from the *A. ferox* plant are harvested in the wild. The full range is available on <http://www.aloe.co.za> (> buy products)

- A range of health products and supplements
- Body care
- Hair care

- Sun care
- Bath range
- Products for men.

7.3.2 COMPANY NAME: ALOE FEROX

Website	http://www.aloeferoxafrica.com/default.asp
Contact address	Aloe Ferox Trust, P.O. Box 25 Albertinia 6695, South Africa Tel.: +27 (0)28 735 2504 Fax: +27 (0)28 735 1092 E-mail: info@aloeferoxafrica.com

CERTIFICATIONS, BEST PRACTICES, MEMBERSHIPS

- GMP compliant manufacturing facility
- Members of the Society of Cosmetics Chemist and the IFSCC
- CITES and Bio-prospecting permit
- Member and contributor to The Aloe Council of SA
- FDA registration no: 11963774260.

PRODUCTS

Aloe Ferox focuses on manufacturing a range of end user-products from *A. ferox* raw materials harvested from the wild. A full range of products can be obtained from their website <http://www.aloeferoxafrica.com/productoverview.asp>

- Baby care
- Body and bath care
- Delicatessen
- Gents products
- Hair care
- Pet products
- Skin products
- Sun care
- Health supplements.

7.3.3 COMPANY NAME: AFRICAN CURES

Website	http://www.africancures.co.za
Contact address	P.O. Box 34805, Newton Park, Port Elizabeth 6055 Tel.: +27 (0)41-3653247 Fax: +27 (0)41-3653256 E-mail: sales@africancures.co.za

CERTIFICATIONS

- ISO2200
- Medicines Control Council registration of products
- Farm Feeds registration
- BEE
- Halaal certification on selected products.

PRODUCTS

- Prosit suspension

- Prosit alcohol free suspension
- Prosit capsules
- SA Cape Aloe granules
- SA Cape Aloe powder
- Prosit Capsules- veggie
- Protick Aloe powder (low aloin content)
- Aloe granules (high aloin content).

7.4 *A. marlothi* producers

7.4.1 COMPANY NAME: UMNAMBITHI ALOE MANUFACTURING COOPERATIVE



Contact address

P.O. Box 2161, Ladysmith 3370, KwaZulu-Natal, South Africa
 CEO: Eric Ndlovu Mobile: +27 (0)829351911
 E-mail: ndlovuem12@gmail.com

CERTIFICATIONS, BEST PRACTICES, MEMBERSHIPS

Permit from wildlife KZN Parks Board for harvesting in the wild

PRODUCTS

- *A.marlothi* hand and body lotion
- Soap
- Shower gel
- Aloe health drink.

RAW MATERIAL CAPACITY

210 ton per annum

7.5 Industrial organisations

7.5.1. THE ALOE COUNCIL OF SOUTH AFRICA

Website	http://www.aloesa.co.za/
Contact address	The Aloe Council of South Africa NPC P.O. Box 199, Albertinia 6695 Cell: +27 (0)72 253 1911 Fax: +27 (0)86 616 0543 E-mail: anitan@organicaloe.co.za

7.5.2 COSMETIC EXPORT COUNCIL OF SOUTH AFRICA (CECOSA)

Website	http://www.cecosa.co.za
Contact address	Adele Visser P.O. Box 9344, Edenglen 1613 Microtek Business Park, 86 John Voster Avenue, Randpark Ridge 2156 Tel.: +27 (0)11- 795 4272 Fax: +27 (0)11- 794 3039 Tel.: +27 (0) 83 278 6797 Fax: +27 (0) 86 730 0840 E-mail: adele@cecosa.co.za E-mail: cecosa86@gmail.co.za

7.5.3 HEALTH PRODUCTS ASSOCIATION OF SOUTHERN AFRICA

Website	http://www.hpasa.co.za/
Contact address	Health Products Association of Southern Africa Postal address P.O. Box 55544, Northlands 2116, Gauteng, South Africa Physical address Canyon House, 61 Main Street, Bordeaux 2194, Gauteng, South Africa Tel./fax: +27 (0)11 789 4464 E-mail: hpasa@hpasa.co.za

7.5.4 MEDICINES CONTROL COUNCIL OF SOUTH AFRICA (MCCSA)

Website	http://www.mccza.com
Contact address	Postal address Registrar of Medicines, Private Bag X828, Pretoria 0001 Physical address Civitas Building, 42 Thabo Sehume Street (previously Andries Street), Pretoria 0001 General enquiries: Main switchboard: +27 (0)12 395 8000

8. KEY REFERENCES

- 1 Hank Schultz, 12-Nov-2012 Global aloe market estimated at \$13 billion. <http://www.nutraingredients-usa.com/Markets/Global-aloe-market-estimated-at-13-billion> (Accessed: 8 Jul, 2014)
- 2 Natural products insider. Aloe vera: The Next Superstar of the Plant World, January 21, 2014 by Tom Vierhile (Tom Vierhile is the Innovation Insights Director for Datamonitor Consumer) <http://www.naturalproductsinsider.com/articles/2014/01/aloe-vera-the-next-superstar-of-the-plant-world.aspx> (Accessed: 20 Jun, 2014)
- 3 Natural products insider. Aloe vera: The Next Superstar of the Plant World, January 21, 2014 by Tom Vierhile <http://www.naturalproductsinsider.com/articles/2014/01/aloe-vera-the-next-superstar-of-the-plant-world.aspx> (Tom Vierhile is the Innovation Insights Director for Data- monitor Consumer) (Accessed: 20 Jun, 2014)
- 4 Natural products insider. Aloe vera: The Next Superstar of the Plant World, January 21, 2014 by Tom Vierhile (Tom Vierhile is the Innovation Insights Director for Datamonitor Consumer) <http://www.naturalproductsinsider.com/articles/2014/01/aloe-vera-the-next-superstar-of-the-plant-world.aspx> (Accessed: 20 Jun, 2014)
- 5 © Euromonitor International. Passport. Aloe vera: Ready for Mainstream Health and Wellness? 9 Jan, 2012. <http://www.portal.euromonitor.com/> (Accessed: 9 Jun, 2014)
- 6 Natural Product Insider. Aloe vera: The Next Superstar of the Plant World. <http://www.naturalproductsinsider.com/articles/2014/01/aloe-vera-the-next-superstar-of-the-plant-world.aspx?pg=2> January 21, 2014 By Tom Vierhile (Accessed: 20 Jun, 2014)
- 7 © Euromonitor International. Passport. Superfruit Juice Should Learn from RTD Tea. 13 Sep 2012 <http://www.portal.euromonitor.com/> (Accessed: 30 Jun, 2014)
- 8 AloeGoe home. <http://www.aloegloe.com/Home.html> (Accessed: 21 Jul, 2014)
- 9 Naturalproductsinsider. Aloe vera: The Next Superstar of the Plant World <http://www.naturalproductsinsider.com/articles/2014/01/aloe-vera-the-next-superstar-of-the-plant-world.aspx?pg=2> January 21, 2014 By Tom Vierhile (Accessed: 30 Jun, 2014)
- 10 © Euromonitor International. Water, Juice and RTD Tea Boosting Growth in Health and Wellness Soft Drinks, Videocast, 8 Jul, 2014 <http://www.portal.euromonitor.com/> (Accessed: 21 Jul, 2014)
- 11 © Euromonitor International. Water, Juice and RTD Tea Boosting Growth in Health and Wellness Soft Drinks, Videocast, 8 Jul, 2014 <http://www.portal.euromonitor.com/> (Accessed: 21 Jul, 2014)
- 12 © Euromonitor International. Water, Juice and RTD Tea Boosting Growth in Health and Wellness Soft Drinks, Videocast, 8 Jul, 2014 <http://www.portal.euromonitor.com/> (Accessed: 21 Jul, 2014)
- 13 © Euromonitor International. Water, Juice and RTD Tea Boosting Growth in Health and Wellness Soft Drinks, Videocast, 8 Jul, 2014 <http://www.portal.euromonitor.com/> (Accessed: 21 Jul, 2014)
- 14 © Euromonitor International. Functionality, New Technology and Stevia Drive Innovation in Beverages. 9 October 2012. <http://www.portal.euromonitor.com/> (Accessed: 30 Jul, 2014)
- 15 © Euromonitor International. Water, Juice and RTD Tea Boosting Growth in Health and Wellness Soft Drinks, Videocast, 8 Jul, 2014 <http://www.portal.euromonitor.com/> (Accessed: 21 Jul, 2014)
- 16 © Euromonitor International. Passport. Superfruit Juice Should Learn from RTD Tea. 13 Sep 2012 <http://www.portal.euromonitor.com/> (Accessed: 30 Jun, 2014)
- 17 © Euromonitor International. Passport. Aloe vera: Ready for Mainstream Health and Wellness? 9 Jan, 2012. (Accessed: 9 Jun, 2014)
- 18 African Aloe home page. http://www.africanaloe.com/listings/fruits_of_the_karoo_beverages (Accessed: 9 Jun, 2014)
- 19 © Euromonitor International. Passport. Aloe vera: Ready for Mainstream Health and Wellness? 9 Jan, 2012. <http://www.portal.euromonitor.com/> (Accessed: 9 Jun, 2014)
- 20 © Euromonitor International. Passport. Aloe vera: Ready for Mainstream Health and Wellness? 9 Jan, 2012. <http://www.portal.euromonitor.com/> (Accessed: 9 Jun, 2014)
- 21 © Euromonitor International. Passport. Aloe vera: Ready for Mainstream Health and Wellness? 9 Jan, 2012. <http://www.portal.euromonitor.com/> (Accessed: 9 Jun, 2014)
- 22 African Aloe home page http://www.africanaloe.com/listings/health_juices (Accessed: 9 Jun, 2014)
- 23 A. ferox home page. <http://www.aloeferoxfrica.com> (Accessed; 30 Jul, 2014)
- 24 © Euromonitor International. Passport. Aloe vera: Ready for Mainstream Health and Wellness? 9 Jan, 2012. <http://www.portal.euromonitor.com/> (Accessed: 9 Jun, 2014)
- 25 © Euromonitor International. Passport. Aloe vera: Ready for Mainstream Health and Wellness? 9 Jan, 2012. <http://www.portal.euromonitor.com/> (Accessed: 9 Jun, 2014)
- 26 © Euromonitor International. Passport. Aloe vera: Ready for Mainstream Health and Wellness? 9 Jan, 2012. <http://www.portal.euromonitor.com/> (Accessed: 9 Jun, 2014)
- 27 © Euromonitor International. Passport. Aloe vera: Ready for Mainstream Health and Wellness? 9 Jan, 2012. <http://www.portal.euromonitor.com/> (Accessed: 9 Jun, 2014)

- 28 © Euromonitor International. Passport. Probiotics: The Trend Continues.07 Feb. 2012. <http://www.portal.euromonitor.com/> (Accessed: 30 Jun, 2014)
- 29 © Euromonitor International. Passport. Probiotics: The Trend Continues.07 Feb. 2012. <http://www.portal.euromonitor.com/> (Accessed: 30 Jun, 2014)
- 30 Jones, N. Nature. Friendly bacteria cheer up anxious mice. Probiotics affect behaviour and brain chemistry. http://www.nature.com/news/2011/110830/full/news.2011.510.html?WT.mc_id=FBK_NPG Referenced from Bravo, J. A. *et al.* Proc. Natl Acad. Sci. US Advance online publication, 2011. (Accessed: 15 Aug, 2014)
- 31 Jones, N. Nature. Friendly bacteria cheer up anxious mice. Probiotics affect behaviour and brain chemistry. http://www.nature.com/news/2011/110830/full/news.2011.510.html?WT.mc_id=FBK_NPG Referenced from Bravo, J. A. *et al.* Proc. Natl Acad. Sci. US Advance online publication, 2011. (Accessed: 15 Aug, 2014)
- 32 NutraIngredients. Orafit consolidates science for inulin, oligofructose by Stephen Daniells in Boston, 02-Oct-2006. Science — consolidation and breakthroughs — took centre stage at the 5th Orafit Research Conference as world-leading scientists convened to discuss prebiotics. <http://www.nutraingredients.com/Research/Orafit-consolidates-science-for-inulin-oligofructose> (Accessed: 30 Jul, 2014)
- 33 © Euromonitor International. Passport. Probiotics: The Trend Continues.07 February 2012. <http://www.portal.euromonitor.com/> (Accessed: 30 Jun, 2014)
- 34 © Euromonitor International. Passport. Aloe vera: Ready for Mainstream Health and Wellness? 9 Jan, 2012. <http://www.portal.euromonitor.com/> (Accessed: 9 Jun, 2014)
- 35 Risk Profile, Aloe vera, CAS no. 85507-69-3 (Aloe vera monograph of the Council of Europe, 2008). [http://www.mattilsynet.no/kosmetikk/stoffer_i_kosmetikk/risk_profile_aloe_barbadosensis_miller_extract.10177/binary/Risk%20Profile%20Aloe%20Barbadosensis%20\(Miller\)%20Extract](http://www.mattilsynet.no/kosmetikk/stoffer_i_kosmetikk/risk_profile_aloe_barbadosensis_miller_extract.10177/binary/Risk%20Profile%20Aloe%20Barbadosensis%20(Miller)%20Extract) Reporting: 13 May, 2015 (Accessed: 26 Jun, 2014).
- 36 Skinwhiteningscience. Top skin whitening agents top 20 aloesin. http://www.skinwhiteningscience.com/top_skin_whitening_agents_top_20_aloesin.html (accessed: 30 Jul, 2014)
- 37 © Euromonitor International. South Africa becomes an attractive prospect. Euromonitor from trade sources/national statistics <http://www.portal.euromonitor.com/> 18 October,2006. (Accessed: 30 Jul, 2014)
- 38 © Euromonitor International. South Africa becomes an attractive prospect. Euromonitor from trade sources/national statistics <http://www.portal.euromonitor.com/> 18 October,2006. (Accessed: 30 Jul, 2014)
- 39 © Euromonitor International. South Africa becomes an attractive prospect. Euromonitor from trade sources/national statistics <http://www.portal.euromonitor.com/> 18 October,2006. (Accessed: 30 Jul, 2014)
- 40 Hank Schultz, 12-Nov.-2012 Global aloe market estimated at \$13 billion. <http://www.nutraingredients-usa.com/Markets/Global-aloe-market-estimated-at-13-billion> (Accessed: 8 Jul, 2014).
- 41 © Euromonitor International. Consumer Health: Euromonitor from trade sources/national statistics <http://www.portal.euromonitor.com/> (Accessed: 21 Jul, 2014)
- 42 SABS home page <https://www.sabs.co.za/> (accessed: 28 Jun, 2014)
- 43 American Herbal Pharmacopoeia (AHP) home page <http://www.herbal-ahp.org> a copy of a 2012 Aloe vera monograph is available on http://www.cosmesi.it/Portals/7/Documenti/Monograph%20AHP_Aloe_vera_leaf_.pdf (Accessed: 28 Jun, 2014)
- 44 ITC 2012. The North American market for natural products. Prospects for Andean and African products. Page 29 www.intracen.org/workarea/downloadasset.aspx?id=58174 (Accessed: 28 Jun, 2014)
- 45 SABS online store. <http://www.store.sabs.co.za/arp-029-2013-ed-1-00-232151> (Accessed: 27 Jun, 2014)
- 46 American Health products Association. Good agricultural and collection practices for herbal raw materials. December 2006 http://www.ahpa.org/portals/0/pdfs/06_1208_ahpa-ahp_gacp.pdf (Accessed: 27 Jun, 2014)
- 47 WHO. Good agricultural and collection practices for medicinal plants. 2003 <http://apps.who.int/medicinedocs/pdf/s4928e/s4928e.pdf> (Accessed: 27 Jun, 2014)
- 48 FairWild Foundation. FairWild Standard. <http://www.fairwild.org/standard> (Accessed: 27 Jun, 2014)
- 49 Fair for fair life business. http://www.imo.ch/logicio/pmws/indexDOM.php?client_id=imo&page_id=ftfl (Accessed: 19 Aug, 2014)
- 50 FDA. Principles for Hazard Analysis and Critical Control Points (HACCP) <http://www.fda.gov/Food/GuidanceRegulation/HACCP/default.htm> (Accessed: 27 Jun, 2014)
- 51 World Health Organization. Good Manufacturing Practices. http://www.who.int/biologicals/vaccines/good_manufacturing_practice/en/ (Accesses: 30 Jun, 2014)
- 52 Forensic Pharmacy Corner. GMP rules. <http://www.doms.co.za/fpc25/index.php/articles/specific-topic-notes/gmp-rules> (Accessed; 30 Jun, 2014)
- 53 Forensic Pharmacy Corner. GMP rules. <http://www.doms.co.za/fpc25/index.php/articles/specific-topic-notes/gmp-rules> (Accessed; 30 Jun, 2014)
- 54 Medicines Control Council. Good manufacturing practices. http://www.mccza.com/dynamism/default_dynamic.asp?grpID=29&doc=dynamic_generated_page.asp&categID=148&groupID=29 (Accessed: 30 Jun, 2014)

- 55 Health products Association of Southern Africa. <http://www.hpasa.co.za/> (Accessed: 30 Jun, 2014)
- 56 FDA. Current good manufacturing practices (CGMPs) <http://www.fda.gov/food/guidanceregulation/cgmp/default.htm#> (Accessed: 27 Jun, 2014)
- 57 Guidance for Industry: Current good manufacturing practice in Manufacturing, Packaging, Labeling, or Holding Operations for Dietary Supplements; Small Entity Compliance Guide December 2010 <http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/DietarySupplements/ucm238182.htm> (Accessed: 27 Jun, 2014)
- 58 Federal Register. Current good manufacturing practice in manufacturing, packaging, labeling, or holding operations for dietary supplements. A Rule by the Food and Drug Administration on 06/25/2007 <https://www.federalregister.gov/articles/2007/06/25/07-3039/current-good-manufacturing-practice-in-manufacturing-packaging-labeling-or-holding-operations-for> (Accessed: 27 Jun, 2014)
- 59 Health Canada. Good manufacturing practices (GMP) Guidelines <http://www.hc-sc.gc.ca/dhp-mps/compli-conform/gmp-bpf/docs/gui-0001-eng.php> and pdf version http://www.hc-sc.gc.ca/dhp-mps/alt_formats/pdf/compli-conform/gmp-bpf/docs/gui-0001-eng.pdf (Accessed: 27 Jun, 2014)
- 60 ITC 2012. The North American market for natural products. Prospects for Andean and African products. Page 30 www.intracen.org/workarea/downloadasset.aspx?id=58174 (Accessed: 28 Jun, 2014)
- 61 FDA. Regulations on Bio-terrorism Act 2002. <http://www.fda.gov/regulatoryinformation/legislation/ucm148797.htm> (Accessed: 27 Jun, 2014)
- 62 ITC 2012. The North American Market for natural products. Prospects for Andean and African products. www.intracen.org/workarea/downloadasset.aspx?id=58174 (Accessed: 30 Jun, 2014)
- 63 Health Canada. Compendium of Monographs <http://www.hc-sc.gc.ca/dhp-mps/prodnatur/applications/licen-prod/monograph/index-eng.php> (Accessed: 30 Jun, 2014)
- 64 US Pharmacopeia Convention (USP). USP Dietary Supplement Standards <http://www.usp.org/dietary-supplements/overview> (Accessed: 30 Jun, 2014)
- 65 Council of Europe. European Pharmacopoeia 8th edition. <http://www.edqm.eu/en/european-pharmacopoeia-8th-edition-1563.html> (Accessed: 30 Jun, 2014)
- 66 European Commission. Health and Consumers. Food Supplements. http://ec.europa.eu/food/food/labellingnutrition/supplements/index_en.htm (Accessed: 30 Jun, 2014)
- 67 Rodriguez *et al.* 2005. Aloe vera. A chapter in the Encyclopaedia of Dietary Supplements, Second Edition, by Informa Healthcare. Pp 7-14, ISBN-13: 9781439819289 http://curezone.com/upload/PDF/zlatin/Encyclopedia_of_Dietary_Supplements_2nd_ed_P_Coates_et_al_Informa_2010.pdf (Accessed: 26 Jun, 2014)
- 68 International Aloe Science Council <http://www.iasc.org/> (Accessed: 22 Jun, 2014)
- 69 Cosmetic Ingredient Review Expert Panel (2007). A final assessment report on the safety assessment of various aloe products and published in the Int. J. Toxicol. 26 (Suppl 2):1-50. Review. PubMed PMID: 17613130. As quoted in Risk Profile, Aloe vera, CAS no. 85507-69-3 (Aloe vera monograph of the Council of Europe, 2008). [http://www.mattilsynet.no/kosmetikk/risk_profile_aloe_barbadensis_miller_extract.10177/binary/Risk%20Profile%20Aloe%20Barbadensis%20%28Miller%29%20Extract](http://www.mattilsynet.no/kosmetikk/stoffer_i_kosmetikk/risk_profile_aloe_barbadensis_miller_extract.10177/binary/Risk%20Profile%20Aloe%20Barbadensis%20%28Miller%29%20Extract) (Accessed: 22 July, 2014)
- 70 National Toxicology Programme. https://www.niehs.nih.gov/health/materials/aloe_vera_508.pdf Headquartered at the National Institute of Environmental, Health Sciences NIH-HHS, US. (Accessed: 26 Jun, 2014)
- 71 American Herbal Pharmacopoeia (AHP) home page <http://www.herbal-ahp.org> a copy of a 2012 Aloe vera monograph is available on http://www.cosmesi.it/Portals/7/Documenti/Monograph%20AHP_Aloe_vera_leaf_.pdf (Accessed: 28 Jun, 2014)
- 72 United States Pharmacopeia home page. <http://www.usp.org/dietary-supplements/development-process/priority-new-dietary-supplement-monographs> (Accessed: 28 Jun, 2014)
- 73 ITC 2012. The North American market for natural products. Prospects for Andean and African products. www.intracen.org/workarea/downloadasset.aspx?id=58174 (Accessed: 28 Jun, 2014)
- 74 Rodriguez *et al.* 2005. Aloe vera. A chapter in the Encyclopaedia of Dietary Supplements, Second Edition, by Informa Healthcare. Pp 7-14, ISBN-13: 9781439819289 http://curezone.com/upload/PDF/zlatin/Encyclopedia_of_Dietary_Supplements_2nd_ed_P_Coates_et_al_Informa_2010.pdf (Accessed: 26 Jun, 2014)
- 75 Risk Profile, Aloe vera, CAS No. 85507-69-3 (Aloe vera monograph of the Council of Europe, 2008). [http://www.mattilsynet.no/kosmetikk/stoffer_i_kosmetikk/risk_profile_aloe_barbadensis_miller_extract.10177/binary/Risk%20Profile%20Aloe%20Barbadensis%20\(Miller\)%20Extract](http://www.mattilsynet.no/kosmetikk/stoffer_i_kosmetikk/risk_profile_aloe_barbadensis_miller_extract.10177/binary/Risk%20Profile%20Aloe%20Barbadensis%20(Miller)%20Extract) Reporting: 13 May, 2015 (Accessed: 26 Jun, 2014).
- 76 ITC 2012. The North American market for natural products. Prospects for Andean and African products. www.intracen.org/workarea/downloadasset.aspx?id=58174 (Accessed: 28 Jun, 2014)
- 77 FDA. <http://www.fda.gov/Food/Dietarysupplements/default.htm> (Accessed: 27 Jun, 2014)
- 78 Health Canada. Drugs and Health Products. Site Licensing. <http://www.hc-sc.gc.ca/dhp-mps/prodnatur/applications/licen-site-exploit/index-eng.php> (Accessed: 27 Jun, 2014)

- 79 Health Canada. <http://www.hc-sc.gc.ca/dhp-mps/prodnatur/applications/licen-prod/lnhpd-bdpsnh-eng.php> (Accessed: 27 Jun, 2014)
- 80 FDA. Cosmetics. Guidance and Regulation. <http://www.fda.gov/cosmetics/guidanceregulation/default.htm> (Accessed: 27 Jun, 2014)
- 81 FDA. Fair Packaging and Labeling Act. <http://www.fda.gov/regulatoryinformation/legislation/ucm148722.htm> (Accessed: 27 Jun, 2014)
- 82 Health Canada. Cosmetics. <http://www.hc-sc.gc.ca/cps-spc/cosmet-person/index-eng.php> (Accessed: 27 Jun, 2014)
- 83 European Commission. Health and Consumers. Food Hygiene. Basic legislation. http://ec.europa.eu/food/food/biosafety/hygienelegislation/comm_rules_en.htm (Accessed: 4 Aug, 2014)
- 84 European Commission. Enterprise and Industry. REACH - Registration, Evaluation, Authorisation and Restriction of Chemicals http://ec.europa.eu/enterprise/sectors/chemicals/reach/index_en.htm (Accessed: 4 Aug, 2014)
- 85 IASC. IASCA Position on A. vera and REACH. http://iasc.org/pdfs/10_0811_IASC_Position_on_Aloe_vera_and_REACH.pdf (Accessed: 4 Aug, 2014)
- 86 IASC. Understanding the REACH Regulations. DRAFT. http://iasc.org/pdfs/10_0813_Understanding_the_REACH_Regulations_DRAFT_IASC.pdf (Accessed: 4 Aug, 2014)
- 87 European Commission. Health and Nutrition Claims. http://ec.europa.eu/food/food/labellingnutrition/claims/index_en.htm (Accessed: 4 Aug, 2014)
- 88 IASC. Inside Aloe Online. November 2010. http://iasc.org/pdfs/10_1116_InsideAloeOnline_November2010.pdf (Accessed: 4 Aug, 2014)
- 89 IASC. Inside Aloe Online. November 2010. http://iasc.org/pdfs/10_1116_InsideAloeOnline_November2010.pdf (Accessed: 4 Aug, 2014)
- 90 EC. Review of the Cosmetic Directive. http://ec.europa.eu/consumers/archive/sectors/cosmetics/documents/revision/index_en.htm (Accessed: 4 Aug, 2014)
- 91 European Union Register of Feed Additives Pursuant to Regulation (EC) No 1831/2003, Annex II page 227 (Annex I of Regulation No 1831/2003). http://ec.europa.eu/food/food/animalnutrition/feedadditives/registeradditives_en.htm Released 20 Jun, 2014 (Accessed: 26 Jun, 2014)
- 92 Academia. Chinese and European Regulations on Novel Foods and Health Foods (Anu Lähtenmäki-Uutela, LL.D., M.Sc. (Econ.), University of Turku, Finland https://www.academia.edu/246502/European_and_Chinese_Law_on_Health_Foods_and_Novel_Foods_2010 (Accessed: 4 Aug, 2014)
- 93 Food Navigator. China introduces new novel foods regulation. By George Reynolds, 24 Jul 2007 <http://www.foodnavigator-asia.com/Policy/China-introduces-new-novel-foods-regulation> (Accessed: 5 Aug, 2015)
- 94 Wong, A.W. Intertek Cantox. Ingredient Regulations in Asia: Opportunities and Challenges <http://www.intertek.com/food/consulting/asia-food-ingredient-regulations-opportunities-challenges/> (Accessed: 5 Aug, 2014)
- 95 Academia. Chinese and European Regulations on Novel Foods and Health Foods (Anu Lähtenmäki-Uutela, LL.D., M.Sc. (Econ.), University of Turku, Finland https://www.academia.edu/246502/European_and_Chinese_Law_on_Health_Foods_and_Novel_Foods_2010 (Accessed: 4 Aug, 2014)
- 96 Academia. Chinese and European Regulations on Novel Foods and Health Foods (Anu Lähtenmäki-Uutela, LL.D., M.Sc. (Econ.), University of Turku, Finland https://www.academia.edu/246502/European_and_Chinese_Law_on_Health_Foods_and_Novel_Foods_2010 (Accessed: 4 Aug, 2014)
- 97 Wong, A.W. Intertek Cantox. Ingredient Regulations in Asia: Opportunities and Challenges <http://www.intertek.com/food/consulting/asia-food-ingredient-regulations-opportunities-challenges/> (Accessed: 5 Aug, 2014)
- 98 Rodriguez *et al.* 2005. Aloe vera. A chapter in the Encyclopaedia of Dietary Supplements, 2nd Edition, by Informa Healthcare. Pp 7-14, ISBN-13: 9781439819289 http://curezone.com/upload/PDF/zlatin/Encyclopedia_of_Dietary_Supplements_2nd_ed_P_Coates_et_al_Informa_2010.pdf p 13 (Accessed: Jul , 2014)
- 99 Wong, A.W. Intertek Cantox. Ingredient Regulations in Asia: Opportunities and Challenges <http://www.intertek.com/food/consulting/asia-food-ingredient-regulations-opportunities-challenges/> (Accessed: 5 Aug, 2014)
- 100 Rodriguez *et al.* 2005. Aloe vera. A chapter in the Encyclopaedia of Dietary Supplements, 2nd Edition, by Informa Healthcare. Pp 7-14, ISBN-13: 9781439819289 http://curezone.com/upload/PDF/zlatin/Encyclopedia_of_Dietary_Supplements_2nd_ed_P_Coates_et_al_Informa_2010.pdf p 13 (Accessed: Jul , 2014)
- 101 Knapp, A. TRAFFIC report. A review of the trade in Aloe ferox, with a focus on the role of the European Union. August 2006. www.traffic.org/species-reports/traffic_species_plants1.pdf (Accessed: 1 Aug, 2014)
- 102 Rodriguez *et al.* 2005. Aloe vera. A chapter in the Encyclopaedia of Dietary Supplements, Second Edition, by Informa Healthcare. Pp 7-14, ISBN-13: 9781439819289 http://curezone.com/upload/PDF/zlatin/Encyclopedia_of_Dietary_Supplements_2nd_ed_P_Coates_et_al_Informa_2010.pdf (Accessed: Jul , 2014)
- 103 International Aloe Science Council. Aloe Science Primer. http://www.iasc.org/pdfs/IASC_Aloe_vera_A_Scientific_Primer.pdf (Accessed: 8 Jul, 2014)

- 104 Viljoen, P. MD of AloWay Health Products. Telephone conversation with the author. September 2014.
- 105 International Aloe Science Council. Aloe Science Primer. http://www.iasc.org/pdfs/IASC_Aloe_vera_A_Scientific_Primer.pdf (Accessed: 8 Jul, 2014)
- 106 Rodriguez, S. Presentation on World Aloe Cultivation, Production and Market. <http://www.scribd.com/doc/206130838/Aloe-Market-Presentation#> (Accessed: 1 Aug , 2014)
- 107 Hank Schultz, 12 Nov 2012. Global aloe market estimated at \$13 billion. <http://www.nutraingredients-usa.com/Markets/Global-aloe-market-estimated-at-13-billion> (Accessed: 8 Aug , 214).
- 108 Rodriguez, S. Presentation on World Aloe Cultivation, Production and Market. <http://www.scribd.com/doc/206130838/Aloe-Market-Presentation#> (Accessed: 1 Aug , 2014)
- 109 Newton and Vaughan (1996). Report on *A ferox* trade, as quoted by Knapp, A. TRAFFIC report. A Review of the trade in *A. ferox*, with a focus on the role of the European Union. August 2006. www.traffic.org/species-reports/traffic_species_plants1.pdf (Accessed: 1 Aug, 2014)
- 110 Knapp, A. TRAFFIC report. A review of the trade in *A. ferox*, with a focus on the role of the European Union. August 2006. www.traffic.org/species-reports/traffic_species_plants1.pdf (Accessed: 1 Aug, 2014)
- 111 Knapp, A. TRAFFIC report. A review of the trade in *A. ferox*, with a focus on the role of the European Union. August 2006. www.traffic.org/species-reports/traffic_species_plants1.pdf (Accessed: 1 Aug, 2014)
- 112 Newton & Vaughan (1996). Report on *A ferox* trade, as quoted by Knapp, A. TRAFFIC report. A Review of the trade in *Aloe ferox*, with a focus on the role of the European Union. August 2006. www.traffic.org/species-reports/traffic_species_plants1.pdf (Accessed: 1 Aug, 2014)
- 113 Knapp, A. TRAFFIC report. A review of the trade in *A. ferox*, with a focus on the role of the European Union. August 2006. www.traffic.org/species-reports/traffic_species_plants1.pdf (Accessed: 1 Aug , 2014)
- 114 Environmental affairs. South Africa's Bioprospecting, Access and Benefit-sharing Regulatory Framework. Guidelines for Providers, Users and Regulators. <http://www.eeu.org.za/DEA%20BABS%20Guidelines%20Web.pdf> (Accessed: 1 Aug 2014)
- 115 Davis. Conductor-orchestra concept. <http://www.aloevera-usa.com/docs/ConductOrch.pdf> (Accessed: 22 Jul, 2014)
- 116 Ramachandra,C.T & Rao, P.S. (2008) on *Processing of A. vera Leaf Gel: A Review* <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 26 May, 2014)
- 117 Plaskett, G on *Aloe vera, The Crucial Importance of Correct Processing*. <http://www.plaskett-international.com/Correct%20Processing.pdf> (Accessed: 22 Jul, 2014)
- 118 Bio-Solve. Production of Aloesin. <http://www.bio-solve.co.za/production-of-aloesin/> (Accessed: 26 Jun, 214)
- 119 Lawless, J. & J. Allan, 2000. *Aloe vera -Natural Wonder Cure*. Harper Collins Publishers. London. Quoted in Ramachandra, C.T and Rao, P.S. (2008) on *Processing of A. vera Leaf Gel: A Review* , page 504 <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 22 Jul, 2014)
- 120 Plaskett, G on *Aloe vera, The Crucial Importance of Correct Processing*. <http://www.plaskett-international.com/Correct%20Processing.pdf> (Accessed: 22 Jul, 2014)
- 121 Plaskett, G on *Aloe vera, The Crucial Importance of Correct Processing*. <http://www.plaskett-international.com/Correct%20Processing.pdf> (Accessed: 22 Jul, 2014)
- 122 Ramachandra,C.T & Rao, P.S. (2008) on *Processing of Aloe Vera Leaf Gel: A Review* <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 22 Jul, 2014)
- 123 Ramachandra,C.T & Rao, P.S. (2008) on *Processing of Aloe Vera Leaf Gel: A Review* <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 22 Jul, 2014)
- 124 Ramachandra,C.T & Rao, P.S. (2008) on *Processing of Aloe Vera Leaf Gel: A Review page 507* <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 22 Jul, 2014)
- 125 Ramachandra,C.T & Rao, P.S. (2008) on *Processing of Aloe Vera Leaf Gel: A Review page 507* <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 22 Jul, 2014)
- 126 Coats, B.C.,1979. Hypoallergic stabilized Aloe vera gel. US patent 4; 178, 372. As quoted in Ramachandra,C.T and Rao, P.S. (2008) on *Processing of Aloe Vera Leaf Gel: A Review, page 503* <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 22 Jul, 2014)
- 127 Ramachandra,C.T and Rao, P.S. (2008) on *Processing of Leaf Gel: A Review page 507* <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 22 Jul, 2014)
- 128 Ramachandra,C.T and Rao, P.S. (2008) on *Processing of Aloe Vera Leaf Gel: A Review page 507* <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 22 Jul, 2014)
- 129 Plaskett, G on *Aloe vera, The Crucial Importance of Correct Processing*. <http://www.plaskett-international.com/Correct%20Processing.pdf> (Accessed: 22 Jul, 2014)
- 130 Plaskett, G on *Aloe Vera, The Crucial Importance of Correct Processing*. <http://www.plaskett-international.com/Correct%20Processing.pdf> (Accessed: 22 Jul, 2014)

- 131 Ramachandra,C.T & Rao, P.S. (2008) on *Processing of Aloe Vera Leaf Gel: A Review* , page 504 <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 22 Jul, 2014)
- 132 Viljoen, Piet. Conversation with MD, Mr Piet Viljoen. AloWay Natural Health Products. (26 Aug, 2014)
- 133 Simal, S., A Femenia, P. Llull & Rossell C., 2000. Dehydration of aloe vera: Simulation of drying curves and evaluation of functional properties. *J. food Eng.*, 43: 109-114. As quotes in Ramachandra,C.T and Rao, P.S. (2008) on *Processing of Aloe Vera Leaf Gel: A Review* , page 504 <http://www.ijcmas.com/vol-3-3/Shweta%20Chauhan,%20et%20al.pdf> (Accessed: 22 Jul, 2014)
- 134 Miranda M., Vega-Galvez A, Garcia P., Di Scala K., Shi J., Xue S.& Uribe E. Effect of temperature on structural properties of *A. vera* (*Aloe barbadensis* Miller) gel and Weibull distribution for modelling drying process. *Food and Bioproducts Processing* 88 (2010) p 138-144. http://www.academia.edu/5156790/An_analysis_of_the_influence_of_growth_periods_on_physical_appearance_and_acemannan_and_elemental_distribution_of_Aloe_vera_L_gel (Accessed: 22 Jul, 2014)
- 135 Kim S.A, Baek J.H., Lee S.J., Choi S.Y., Hur W. & Lee S.Y. A Novel Method for Air Drying Aloe Leaf Slices by Covering with Filter Papers as a Shrink-Proof Layer. *J.of Food Sci – Vol 74, Nr. 9, 2009.* (Accessed: Jun 2014)
- 136 Frontier Market Network. Local manufacturer acquires advanced processing infrastructure. AloWay Natural Health Products. <http://www.frontiermarketnetwork.com/article/5613-local-manufacturer-acquires-advanced-processing-infrastructure#.U76j9meKDmJ> Wed, 18 Jun 2014 09:00 (Accessed: 4 Aug, 2014)
- 137 Frontier Market Network. Local manufacturer acquires advanced processing infrastructure. AloWay Natural Health Products. <http://www.frontiermarketnetwork.com/article/5613-local-manufacturer-acquires-advanced-processing-infrastructure#.U76j9meKDmJ> Wed, 18 Jun 2014 09:00 (Accessed: 4 Aug, 2014)
- 138 Bio-Solve. Production of Aloesin. <http://www.bio-solve.co.za/production-of-aloesin/> (Accessed: 26 Jun, 2014)