Sudan University of Science and Technology

Faculty of Graduate Studies

Aloe Vera Nano particles and their application as an Anti Bacteria

جسيمات الصبار النانوية وتطبيقها كمضاد للبكتريا

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بسم الله الرحمن الرحيم

الآية

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صدق الله العظيم

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ABESTRACT

Aloe Vera gel is in the form of a gelatinous gel, which hinders its use in many areas, so converting it into powder or Nano powder makes it easier to use and opens the way for many important uses, whether medical or cosmetic. Problems that impede use and to benefit from the moisturizing and lightening elements, the gel is extracted from the plant very carefully to avoid the yellow juice present in the plant because it causes itching and is harmful to the skin. Mix the gel extracted from the plant to get rid of the water. The plant was characterized by the SEM device, where it was converted to nanoparticles with suitable diameters for use and was tested on bacteria that found on the surface of the skin and the effect on the bacteria was balanced, making it suitable for use in many applications.

المستخلص

الالوفيرة جل توجد علي شكل جل هلامي مما يعيق إستخدمها في كثير من المجالات لذلك تحويلها باودر او نانو باودر يسهل من استخدامها ويفسح المجال امام الكثير من الاستخدامات المهمه سوا طبية او تجميلية ولتحويل جل الصبار الي نانو باودر استخدمنا تقنية النانو تكنولوجي للوصول الي كمية مناسبة للاستخدام ومعالجة المشاكل التي تعيق الاستخدام وللاستفادة من عناصر الترطيب والتفتيح , يتم استخراج الجل من النبتة بعناية فائقة لتفادي العصارة الصفراء الموجودة في النبتة لانها تسبب الحكة ومضرة بالبشرة وخلط الجل المستخرج من النبتة للتخلص من الماء وتتم التصفية بورق الترشيح ويتم التجيف بالفريز دراير لتفادي التسخين حتي لانغير من خواص النبات وتم تشخيصه عن طريق جهاز ال SEM حيث تم التاجد من التحول الي حبيبات نانوية باقطار مناسبة للاستخدام وتم اختباره علي بكتريا سطح الجلد وكان التاثير علي البكتريا متوازن مما يجعلها مناسبة للاستخدام في كثير من التطبيقات .

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Chapter One
General Introduction

1.1. Aloe Vera

THE use of aloe Vera is being encouraged for a large variety of conditions. Often general practitioners (GPs) seem to know less than their patients about its alleged benefits. The Department of Complementary Medicine at the University of Exeter receives more enquiries from colleagues related to aloe Vera than for another herbal medicine. Aloe Vera (synonym: *Aloe* barbadensis Miller) belongs to the Liliaceal family, of which there are about 360 spas. Aloecapensis belongs to a different species. Aloe Vera is plant that grows readily in hot, dry climates and currently, because of demand, is cultivated in large quantities. Cosmetic and some medicinal products are made from the mucilaginous tissue in the center of the aloe Vera leaf and called aloe Vera gel. The peripheral bundle sheath cells of aloe Vera produce an intensely bitter, yellow latex, commonly termed aloe juice, or sap, or aloes. Aloe Vera sap and aloe Vera gel are often confused. Unlike aloes, aloe Vera gel contains no anthraquinones, which are responsible for the strong laxative effects of aloes.

1.2 Nanotechnology:

Nanoscience and nanotechnology are the study and application of exceptionally small things. It is a multidisciplinary science that across all the other science fields, such as chemistry, biology, physics, materials science, and engineering. Nanoparticles range in dimension from 1 to 100 nm. They have unique properties compared to their bulk counterparts due to the decrease in dimension to the atomic level. This causes unforeseen properties of nanoparticles. Nanoparticles are synthesized by size reduction using either top-down methods such as milling, high-pressure homogenization and sonication, example: Polymeric nanoparticles can be synthesized from natural and synthetic polymers. Or bottom-up processes like reactive precipitation and solvent displacement.

MN Nanomaterials are excellent adsorbents, catalysts, and sensors due to their large specific surface area and high reactivity. More recently, several natural and engineered nanomaterials have also been shown to have strong antimicrobial properties, (Divya and Jisha, 2018, Agarwal and Dwivedi, 2013).

1.3. Problem state meant:

Aloe Vera is always found in nature in the form of a gel, which represents the main problem that hinders many uses in many important areas, so the need to convert to powder or Nano powder to facilitate use and make maximum use of the contents and use as a powder increases the life of use and reduces the side effects resulting from use

1.4. Objectives

- To produce Aloe Vera Nano-particles from Aloe Vera gel.
- To test antibacterial activity.
- To characterization of Aloe Vera Nano-particles using SEM.

Chapter Two

Literature Review

2.1. Historical background

The word “nanotechnology” was introduced for the first time into a scientific world by Norio Taniguchi at the international conference on industrial production in Tokyo in 1974 in order to label the super thin processing of materials with nanometer accuracy and the creation of nano-sized mechanisms. Ideas of Nano technological strategy, which were put forward by Feynman(known as father of Nanotechnology)in his lecture delivered in1959 at the session of American physical society, In the second half of 1980s to the early 1990s a number of important discoveries and inventions was made, which created an essential impact on the further development of nanotechnology. Since then, a considerable intensification of nanotechnological researches and designs is underway, the number of publications on nanotechnological subjects increases hard, practical application of nanotechnology expands; project financing in nanotechnology increases meaningfully, as well as the number of organizations and countries involved in it. In 1991 the first Nano technological program of National Scientific Fund started to operate in the USA. In 2001 the National Nanotechnological Initiative (NNI) of the USA was approved.the nanotechnology paradigm was formed at the turn of the 1960s, while the 1980s and 1990s are the start of development of nanotechnology in its own right. Accordingly, one could say that the whole dated up to the 1950s may be considered as pre-history of nanotechnology. The end of this period was the appearance of conditions for managed nanotechnology development, which was eased by the scientific and technical revolution(Tolochko, 2009) .

2.2. **Aloe Vera:**

Aloe Vera has been used by mankind for thousands of years in traditional medicine for beneficial properties especially on skin The Greek philosopher Aristotle wrote about the beneficial medicinal effect of Aloe Vera, while references are also found during the Bible 2. The ancient Greeks, Romans, Chinese and Indians used it. By the early 1800s Aloe Vera was served as a laxative in the United States. Moreover, modern clinical use began in the 1930s with reports of successful treatment of x-ray and radium burns (Inkson, 2016). Aloe vera derives its name from the Arabic word "Alloeh" which means "shining bitter substance" because of the bitter liquid found in the leaves and Vera which means" in Latin. This species was first described by Carl Linnaeus who suggested the following classification: Kingdom: plantae, Order: Asparagales, Family: Asphodelaceae, Genus: Aloe, Species: Aloe vera. There are a number of synonyms: Aloe barbadensis Mill., Aloe indica Royle, Aloe perfoliat L. var Vera and Aloe vulgaris Lam(Manojlović, 2018). Most of the Aloe plants are not toxic, but a few are extremely poisonous. There are about four main species of about 420, that have medicinal properties and among them is Aloe vera which is measured to be the most potent and therefore the most popular, also widely grown as an ornamental plant. The natural range of Aloe vera is unclear as the species has been widely cultured throughout the world, rather originating in Africa. It is grown in most subtropical and hot locations including South Africa and Latin America, then it was introduced to China, India and numerous parts of Southern Europe in the 17th century. Aloe vera is a cactus-like plant, although is related to the onion, garlic and asparagus 2. It is stemless with triangular, fleshy leaves ranging in color from grey-green to bright green and in the margin of the leaves has small white teeth(Christaki and Florou-Paneri, 2010, Sharma, 1993, Terefe and Neges, 2017) .

2.3. **Component of aloe Vera**

Studies have found that there are 75 ingredients contained in the Aloe leaf They are divided into the following group:

• Ligin – This cellulose substance is found in the gel has no known medical properties except it posses the property of penetrating the human skin.

• Saponins – These form soapy lathers when mixed and agitated with water. They have been used in detergents, foaming agents and contain antiseptic properties.

• Anthraquinones – There are 12 of these contained in the sap of Aloe Vera: Aloin, Isobarbaloin, Anthracene, Emoting, Ester of Cinnamonic acid, Chrysophanic acid, Barbaloin, Anthranol, Aloetic acid, Aloe Emodin, Ethereal oil and Resistannol. These act as natural laxatives, painkillers and analgesics, and they contain powerful antibacterial, antifungal and virucidal properties.

• Minerals – Aloe Vera contains the following minerals: - Calcium - Manganese - Sodium - Copper - Magnesium - Potassium - Zinc - Chromium - Iron

• Vitamins – Aloe Vera contains numerous vitamins: - Vitamins A, C, & E - Vitamin B & Choline - Vitamin B12 - Folic acid.

• Amino Acids – Amino Acids are the building blocks of protein, which manufacture and repair muscle tissue. The human body requires 22 amino acids and needs 8 essential ones. Aloe Vera provides 20 of 22 required amino acids and 7 of 8 essential ones.

• Enzymes – Some of the most important enzymes in Aloe Vera are: Peroxidase, Aliiase, Catalase, Lipase, Cellulase, Carboxypeptidase, Amylase and Alkaline Phosphatase. Enzymes help to break down food and assist in digestion. Some enzymes help break down fats while others break down starches and sugars.

• Sugars – Aloe Vera contains both monosaccharides, such as glucose and fructose, and polysaccharides. Polysaccharides are the most important types of sugars. They aid in proper digestion, maintain cholesterol levels, improve liver functions and promote the strengthening of bones(BAYATI and MORADI, 2014, Renn and Roco, 2006).

• Sterols – Sterols are important anti-inflammatory agents. The ones found in Aloe Vera are: Cholesterol, Sit sterol, Campestral and Lapel. These sterols contain

antiseptic and analgesic properties. Aloe Vera is an effective way to get these essential nutrients. Aloe Vera can also reduce inflammation to injured tissue. Inflammation occurs when healthy tissue is injured and blood begins to clot around the tissue to healing the injured tissue. Aloe Vera is a natural anti-inflammatory (BAYATI and MORADI, 2014). The benefits of Aloe Vera have long been tested throughout history. It is only in recent years that studies have scientifically proven many of the medicinal benefits of Aloe Vera. Perhaps the longer that scientist and botanists study the benefits of Aloe Vera, the more improvements it will create to human health and well-being(BAYATI and MORADI, 2014, Duncan, 2011).

2.4. Health Benefits of Aloe Vera

Aloe Vera has been used from old time to aid in smooth functioning of the gastrointestinal tract, mainly because of its properties of soothing, cleansing and helping the body to maintain healthy tissues. Aloe Vera gel is famous for facilitating digestion, aiding blood and lymphatic circulation, as well as improving kidney, liver and gall bladder functions. Aloe Vera has a least of three anti-inflammatory fatty acids, which help in smooth functioning of the stomach, small intestines and colon. It has a natural property to alkalize digestive juices and prevents over-acidity, which is one of the common causes of digestive ailments. Aloe vera juice concentrates are high in essential enzymes, which stimulate digestion and liver functions. The synergistic effect of Aloe Vera juice used in combination with a few other herbs does wonders as a liver-cleansing agent. Aloe Vera supplements also contain a rare natural ingredient called Sapiens, which is provided by nature to cleanse and flush out waste products and toxins. More medicinal uses of Aloe vera are described in the following sections. Aloe Vera could be used to reduce the burning sensation of burns and blisters. Applying the pure gel of Aloe vera would quell the sting of herpes. Juice or gel of Aloe vera is used to reduce warts, psoriasis and eczema. Today, skin doctors prescribe skin gels and creams made from Aloe era. The fresh juice of Aloe vera is used to cure and heal rashes, vaginal

infections, foot sores and fungus attack of many types. It is one of the home remedies for these problems. Aloe vera is used in hair loss treatment. The enzyme content of Aloe vera prevents hair loss by protecting the scalp against any diseases. Aloe vera also helps in the reduction of dandruff. You can mix the juice of Aloe vera with coconut milk and wheat germ oil and massage your scalp before shampooing your hair. If used continuously it helps in hair re-growth. There are on-going researches in the medical use of Aloe vera in the treatment and cure of AIDS and cancer. In the cure of cancer, there are many signs that medicines with Aloe vera content help in the activation of WBCs and in promoting the growth of non-cancerous cells. If people with HIV positive take regular doses of Aloe Vera, it helps in increasing the immunity of the body. The juice of Aloe vera mixed with milk is consumed for kidney infections. In Japan, Aloe vera is a main ingredient in the yogurt. In India, Aloe vera is used to make certain food dishes. Aloe vera was used as medicine by the people of the ancient world. The Greeks believe Alexander the Great conquered the island of Socotra, an island in Indian Ocean, because this island had ample growth of Aloe vera plants. Aloe vera is widely used for the following: Boosting of the immune system, As an anti-inflammatory for treating cuts and burns, Providing nutritional supplements(Kumar and Debjit, 2010).

Aloe vera is best known for its soothing and healing effects on burns and other wounds. Studies show that Aloe vera when applied to a wound increase both the rate of wound closure and the tensile strength of the wound through the proliferation of cells, including skin, liver, nerve and blood cell.

One of the key reasons Aloe vera has become so popular among consumers is that it possesses incredible moisturizing properties. Studies show that Aloe vera improves the skin's ability to hydrate itself, aids in the removal of dead skin cells and has an effective penetrating ability that helps transport healthy substances through the skin. Each of these factors make Aloe vera an ideal ingredient in cosmetic and dermatological products. In fact, Aloe vera is presently one of the most important ingredients in the cosmetics industry, being

utilized in over 95% of the dermatologically valuable extracts industrial worldwide.

Antioxidant, anti-microbial and anti-viral--Aloe Vera contains vitamin C, E, zinc and seven superoxide dismutase.

One of its most popular usages these days is in helping any type of digestive or bowel disorder. Aloe vera has received an enormous amount of positive Media for its benefits in helping IBS, irritable bowel syndrome. It is too useful with other digestive problems, counting peptic ulcers or any type of stomach infection. Its properties are those of healing and calming and so it is worth using as a part of a healing programmer on any digestive complaint.

Aloe Vera for A healthy skin Apart from its result on the inner organs, Aloe Vera has a useful effect on the skin.

It is ironic in anti-oxidants, which neutralize free radicals. As a result, Aloe Vera wards off wrinkles and age related change.

It nourishes the skin, by boosting the circulatory system. Aloe Vera is effective in treating skin disorders, like dermatitis, and even psoriasis. It heals cuts and wounds, blisters and burns, including sunburns, and even minor second degree injuries.

Aloe vera clears acne and skin allergies, dark spots and skin blemishes, and makes the skin clearer.

It is also good for the hair and scalp(Kumar and Debjit, 2010).

2.5 Applications of Nanotechnology:

Nanotechnology is doing to particularly progress, many technology, constant transform and different engineering divisions like medicine, cosmetic, energy, environmental science, transportation, and food safety, information technology with lots of others field(Corbett et al., 2000, Ahmed et al., 2009). Recently nanotechnology connect with existing advancement in biotechnology, chemistry, physics and materials science to create modern materials, which have exclusive properties as their arrangements are determined on the nanometer scale. Nanoscale silver also applies in anti-bacterial wound healing

treatment. A gas can be neutralized by nanoscale dry powder. Batteries for tools are being done with nanoscale materials in order to achieve more quickly with less heat and more power. To prevent sunburns from ultraviolet sunlight, a sunscreens containing with nanoscale Zinc Oxide or Titanium Dioxide is used, which can reflect the UV light. Next session a variety of nanoscale based techniques and products based are explained in detail(Barua et al., 2020, Manojlović, 2018) .

2.6. Introduction of Green Nanotechnology

Ideally, nanomaterial development should be join a safety-by-design approach, as there is a marketing edge for nano-enabled products with a reduced potential impact on health and the environment. Such green nanotechnology solutions play a major role in realizing sustainable development goals and eliminate the threat of the technification of development processes. Green Technology (GT) is an environmental healing technology that reduces environmental damages shaped by the products and technologies for peoples' services. It is believed that GT promises to augment farm profitability while reducing environmental degradation and conserving natural resources Green technologies are sustainable technologies which will not create footprint when used for various processes/applications [(Manojlović, 2018)]. Green technologies support the use of natural organic resources and avoid the production of green gasses. They also consume less resources and do not support to increase the entropy of the universe. Green technologies do not support any kind of environmental degradation. They support the automation of every process and therefore avoid human interference. Since they do not support environmental degradation and contribute to creating the footprint, they are sustainable, improve the lifestyle of the people, and contribute to human comfortability. The major technologies used in the present day like Aircraft technology, Automobile technology, Biotechnology, Computer technology, Telecommunication technology, Education technology, Internet technology, Renewable energy technology, Atomic & Nuclear technology, Nanotechnology, Space technology, etc. can be

made green using the principle of green technology. Nanotechnology predicted as to be pioneering technology of the 21st century, if adapted as a green technology, will be accepted by every user and play an important role in solving problems of society at both basic and advanced levels(Aithal and Aithal, 2021, Manojlović, 2018).

2.7. Characterization techniques:

Over the past few decades nano size and nano dimensional materials whose structures exhibit meaningfully novel and improved physical, chemical and biological properties, phenomena, and functionality due to their nanoscaled size, have drawn much interest. Nanophasic and nanostructured materials are also attracting a great deal of attention of the textile and polymer researchers and industrialists because of their potential applications for achieving specific processes and properties, especially for functional and high performance textiles applications. The nanotechnology research in the textile area mainly centres on creating unique properties in everyday fabric such as self-cleaning, water and oil repellency, stain proof, antibacterial, UV protective, antistatic, improved moisture regain and comfort in synthetic based textiles but without compromising the original hand, breathability and durability of the fabric. It also shows promising applications in developing advanced textile materials such as nanocomposite fibres, nanofibres and other nanomaterial incorporated textiles for applications in medical, defence, aerospace and other technical textile applications such as filtration, protective clothing besides a range of smart and intelligent textiles. The fundamental of nanotechnology lies in the fact that properties of materials change dramatically when their size is reduced to the nanometer range. But measuring this nano dimension is not a very easy task. Although research is going on to synthesise nanostructured and nanophasic materials, characterizing these nano sized materials is also an emerging field posing lot of challenges to scientists and technonologists. Thus, nanotechnology has motivated the upsurge in research activities on the discovery and invention of sophisticated nano characterization techniques to

allow a better control of morphology, size and dimensions of materials in nano range(Joshi et al., 2008).

2.8. Freeze-drying

Freeze-drying is a process, in which a product is Rrst frozen and then dried by sublimation of the ice. The total process involves four steps: freezing; sublimation of the ice, called main drying (MD); desorption of the water bound to the solid, called secondary drying (SD); and packing in containers to exclude absorption of water and/or oxygen from the atmosphere. By freeze-drying a product unstable in water is transformed into a dry, stable product. The process has to be developed to satisfy four demands on the Rnished product: its volume remains that of the frozen substance; the structure and the biological activity of the dried solid correspond as far as possible to those of the original substance; the dried product remains stable during storage, if possible at temperatures up to #403C and for up to 2 years; and with the addition of water the original product is quickly reconstituted. This article summarizes the problems and solutions to achieve these aims.

Theoretically, sublimation of ice can be done at atmospheric pressure; however, the vapor pressure of ice between!103C and!403C is approximately 2.6}0.13 mbar and 1 kg of ice has a volume of approximately 470 m3 at !103C and 8400 m3 at !403C. To transport these volumes at atmospheric pressure the gas volume has to be approximately 400}8000 times larger than that of the vapor.

Therefore, all freeze-drying plants today are vacuum plants, in which the air is reduced to some 10% of the vapor pressure, to allow the free Sow of vapor at velocities up to $100 ms^{-1}$(Muzquiz, 2000) .

Chapter Three

Materials and Method

3.1. Materials:

The Aloe Vera were purchased from nursery in Sudan, Methanol by Sudan university laboratories .

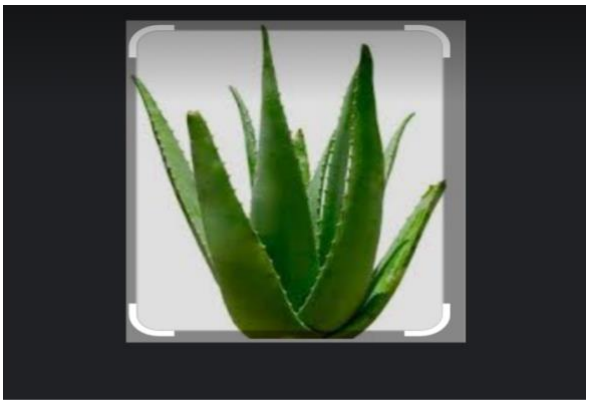


Fig 3.1Aloe Vera plant

3.2. Method

3.2.1 Preparation of gel of Aloe vera

Extracting the transparent gel from the aloe vera plant carefully without the yellow juice because it is harmful to the skin.

The extraction is done by cutting the green part with a knife and lowering the gel into a

Empty cup weight= 99.57g

Sample weight and beaker= 412.91g

Sample weight=313.34g

3.2.2. Mixer

The clear gel is mixed with methanol in a blender to separate the water and filtered with filter paper for filtering.

IN blender 313.34g and 0.05from methanol used for sterilizing.

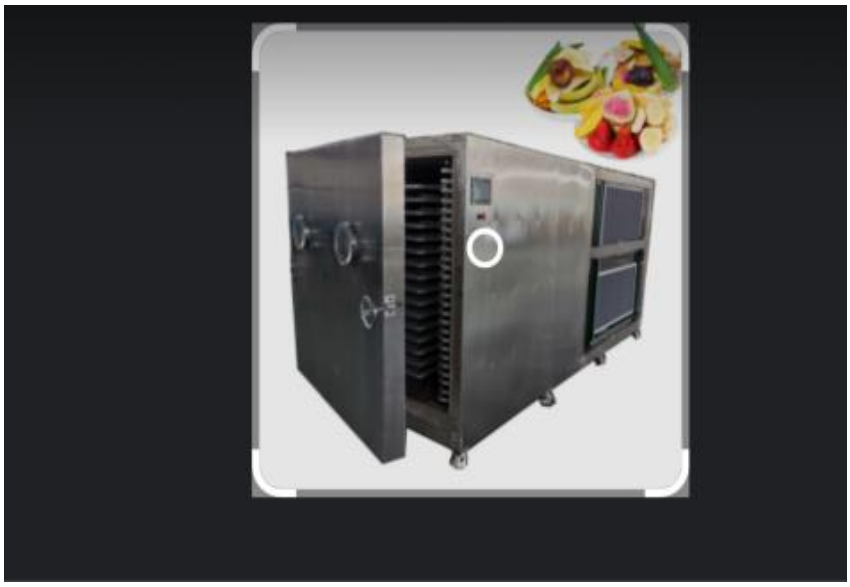
After separating the water from the sample the weight of the sample is 50g.

3.2.3. Freeze Drying

The sample is dried in a freeze dryer

(use the freeze dryer for drying because heating can change the properties of the plant

We inserted the sample for drying for 48 hours.



We obrained 1 g of the sample in the form of aggregated granules.

Fig.3.2. Freeze Dryer

3.2.4.MILL

Take the dried sample and grind it. After drying sample 1g.

We grind it by hand just before use .

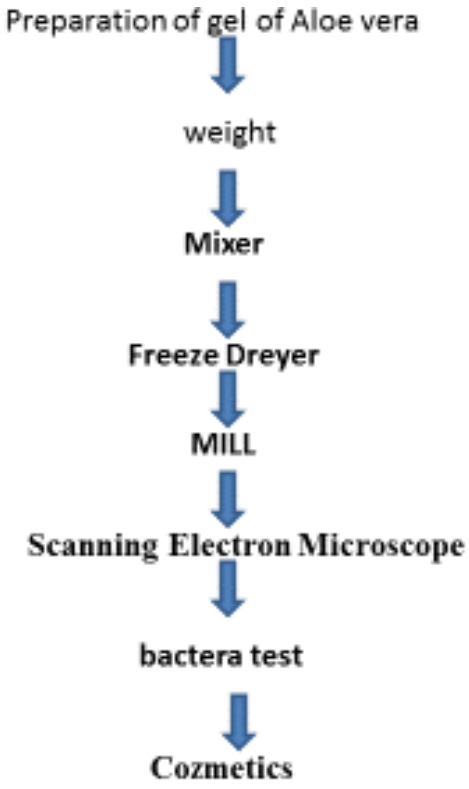
3.2.5. Scanning Electron Microscope:

Inserting the sample into a device to ensure that it is transformed into nanoparticles.

Fig.3.4. Scanning Electron Microscope

Process Flow Chart for biosynthesise of Aloe Vera NPs

:



Process flow chart for biosynthesise of Aloe vera NP.s

3.2.6. Bacteria test:

Method

1. tate stevail media "NUTRIAT AGAR"
2. culcere nutrient agar by (s.epidermad and E.coll)
3. takesespantion by D. water and Aloe Vera nanoparticles IN the center
4. in cubaiun the culcur for incubeder for 24 hour

Result:

S. epidermis sensate: No growth

E. coli ves: stan: growth

Chapter Four

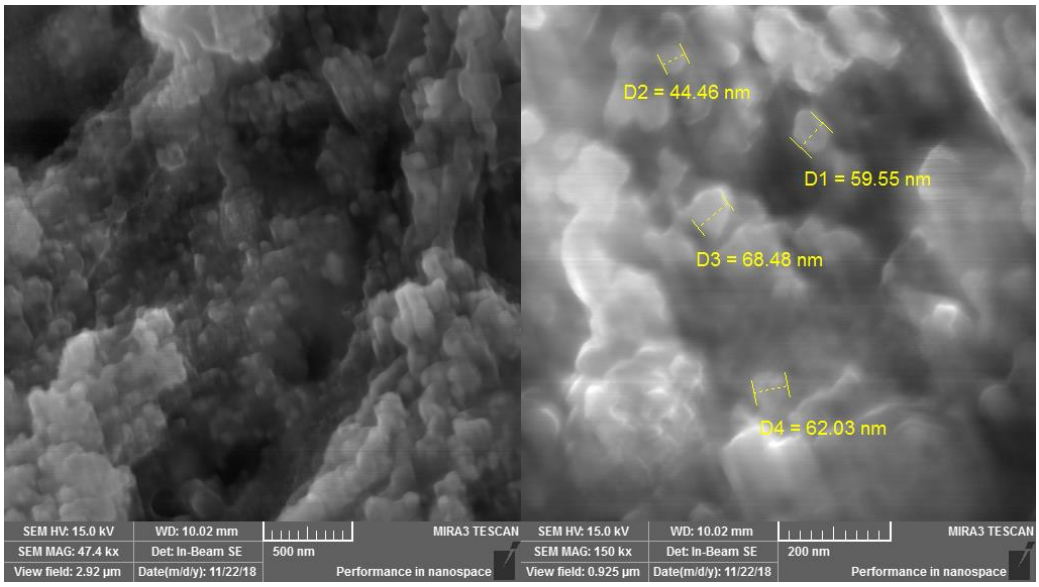
Results and Discussion

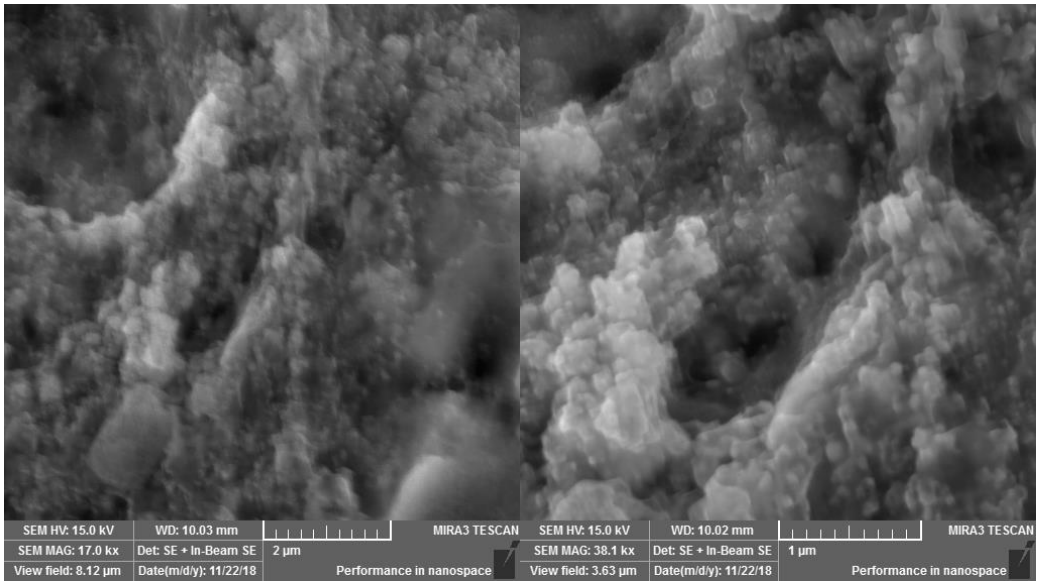
4.1. Preparation of Aloe Vera Gel

Fig.4.1. Aloe Vera Gel

4.2. Characteristics of method

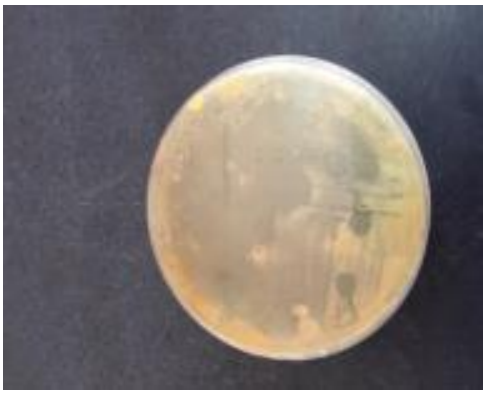
Scanning Electron Microscope





Conversion diameter was (D1=59.55nm, D2=44.46nm, D3=68.48nm,D4=62.03nm).And it was spherical in shape.

4.3. Bacteria test:



Result:

S.ep:dermds sensate :No growth

E.coli ves:stan :growth

The sample with the bacteria, the result was balanced(E.COLI:VES:STAM)AS IT WAS A SUBSTANCE with bacteria and not reactive with bacteria (S.EP:DER MDS)

Chapter five

Conclusion and Recommondations

5.1. Conclusion:

The study four this research aimed at how to convert Alove Vera gel into Nano particles for maximum benefit from its contents. four days after opening the leg containing the leg containing the gel

We took a quantity of gel and mixed it in a blender with a small percentage of methanol for sterilization. After mixing, we got rid of the water by filtering, and the sample was dried by means of a freeze dryer, because heating can change the properties of the materials .and then we grind the sample, take part of it and diagnose it in where it was confirmed that the transformation into nanoparticles was taken and tested with two types of bacteria present on the surface of the skin.

5.2. Recommendations :

The problem was We need large quantities of plants, because in converting the transformed quantity is very simple And the purchase cost is high.

The features were Avoid using the gel directly because it contains a yellow substance that can cause infections and itching of the skin After the transformation, the use is safe, easy and maximum benefit for a longer period of time.

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