



**DEVELOPMENT OF HERBAL NONWOVEN
WOUND DRESSING AND TESTING ITS
ANTIBACTERIAL PROPERTIES**
A PROJECT REPORT



Submitted by

GOWTHAM .V **0910202009**

SHATISH KUMAR .S.K **0910202031**

SHIVA PRAGASH .K **0910202032**

SHRUTHI RAKAVI .M.C **0910202033**

In partial fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

in

TEXTILE TECHNOLOGY

KUMARAGURU COLLEGE OF TECHNOLOGY

COIMBATORE- 641 049

(AN AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI)

ANNA UNIVERSITY, CHENNAI 600025

MAY 2013

BONAFIDE CERTIFICATE

Certified that this project report “**DEVELOPMENT OF HERBAL NON-
WOVEN WOUND DRESSING AND TESTING ITS ANTIBACTERIAL
PROPERTIES**” is the bonafide work of “ GOWTHAM.V (0910202009),
SHATISH KUMAR.S.K(0910202031), SHIVA PRAGASH.K (0910202032),
SHRUTHI RAKAVI.M.C (0910202033)” who carried out the project work
under my supervision.

SIGNATURE

SIGNATURE

Dr.BHAARATHI DHURAI

S.NATARAJAN

HEAD OF THE DEPARTMENT

SUPERVISOR

ASSISTANT PROFESSOR

Department of Textile Technology,

Department of Textile Technology,

Kumaraguru College of Technology,

Kumaraguru College of Technology,

Coimbatore 641 049.

Coimbatore 641 049.

Submitted for the Project Viva- Voce examination held on _____

Internal Examiner

External Examiner

i

ACKNOWLEDGEMENT

We express our sincere gratitude to our beloved Joint correspondent **Mr. K.SHANKAR VANAARAYAR , Dr. S. RAMACHANDRAN**, Principal for their support and allowing to utilize the facilities of the institution.

We are elated to place our thanks to **Dr. BHAARATHI DHURAI**, professor and head, department of textile technology, for his wonderful guidance, variable help and suggestions during his project work.

We give our great pleasure to express our deep sense of gratitude to our supervisor , **S.NATARAJAN** , Assistant Professor , Department of Textile Technology , Kumaraguru College Of Technology for his innovative guidance, suggestion and constant encouragement at every step in the project.

We express our wholehearted thanks to **Mrs. SASIKALA** and **Mrs. SUDHA** for being our part of our project.

We express our wholehearted thank all the technical and non-technical staffs of the department of the textile technology and our friends.

Lastly we extend our immense gratitude of our parents and friends for their unceasing, prayerful, encouragement and moral support.

ABSTRACT

Wound dressing plays a vital role in the medical textiles industry. In our traditional medicine, herbs are extensively used in wound care because of their potent anti-microbial and healing effect. In combination of Herb and textile, herbs provides an anti-microbial protection and textile acts as an external barrier. Alginate exists widely in brown seaweeds, acting as a reinforcing element for cell walls. These fibres have unique gel forming characteristics .The gelled structure helps to keep a moist interface between the dressing and the wound surface, which can assist the healing process.

The aim of this project is to develop a herbal wound dressing and to test its antibacterial properties. Chitosan is produced commercially by deacetylation of chitin, which is the structural element of crustaceans such as (crabs, shrimp and cell walls of fungi).. The wound healing made out of chitosan film can exhibit the biological and physio-chemical characteristics; hence it will enhance the positive effect on wound healing. The herbs used are Tridax procumbens , Aloe vera, Turmeric and Cynodon dactylon.

In this project, herbal extract loaded chitosan with sodium alginate is applied to the bamboo non- woven material in the form of hydrogel and this is used for wound dressing and its antibacterial properties are evaluated using agar diffusion method and mechanical properties such as tensile and elongation are evaluated. It is found that Turmeric has the significant anti bacterial property compared to other herbs (tridax procumbens,cynodon dactylon,aloe vera).

TABLE OF CONTENTS

CHAPTER NO	TITLE	PAGE NO
	ABSTRACT	iii
	LIST OF TABLE	vii
	LIST OF FIGURES	viii
1.	CHAPTER 1	
	INTRODUCTION	1
	1.1 Definition Of Wound	1
	1.2 Classification Of Wound	1
	1.2.1 Open Wound	1
	1.2.2 Closed Wound	2
	1.3 Wound Healing	2
	1.4 Phases Of Wound Healing	3
	1.4.1 Inflammatory Phase	3
	1.4.2 Proliferative Phase	4
	1.4.3 Contraction	4
	1.4.4 Maturation And Remodeling	4
	1.5 Chitosan	5
	1.6 Sodium Alginate	5
	1.7 Aloe Vera	6
	1.8 Turmeric	6
	1.9 Tridax Procumbens	6
	1.10 Cynodon Dactylon	7

iv

2.	CHAPTER 2	
	LITERATURE REVIEW	8
	2.1 Chemical And Biological Properties Of Chitosan	8
	2.2 Method Of Manufacture	10
	2.3 Molecular Weight And Degree Of Deacetylation	12
	2.4 Solubility	12
	2.5 Viscosity (Dynamic)	13
	2.6 Cationic Polyamine	14
	2.7 Application Of Chitosan	14
	2.7.1 Pharmaceutical Application	14
	2.7.2 Controlled Release Dosage Forms	14
	2.7.3 Wound Healing Properties	15
	2.7.4 Rheological Behavior Of Chitosan	15
	2.8 Advantages Of Chitosan Wound Dressing Materials	16
	2.9 Antimicrobial Activity Of Chitosan	17
	2.10 Sodium alginate and its haemostatic properties	17
	2.11 Aloe Vera And Its Uses	22

v

	2.12 Turmeric And Its Uses	24
	2.13 Tridax Procumbens And Its Uses	26
	2.14 Cynodon Dactylon And Its Uses	27
	2.15 Bamboo Fibre And Its Properties	29

3.	CHAPTER 3	
	MATERIALS & METHODS	33
	3.1 Fabric Specifications	33
	3.2 Materials used	33
	3.3 Methodology	34
	3.3.1 Herbal Extract	34
	3.3.2 Hydrogel Formation	34
	3.4 Herbal Extract Preparation	35
	3.5 Hydrogel Formation	36
	3.6 Testing Methods	37
	3.6.1 MIC Test	38
	3.6.2 Antibacterial Test	39
	3.6.3 Mechanical Tests	40

vi

4.	CHAPTER 4	
	RESULT AND DISCUSSION	43
5.	CHAPTER 5	
	CONCLUSION	51
6.	CHAPTER 6	
	REFERENCE	52
	LIST OF TABLES	
	1. Characteristics of pharmaceutical grade chitosan	10
	2. Typical viscosity (dynamic) values for chitosan 1%w/v	13
	3. Anti Bacterial test	46
	4. Water uptake	46
	5. Weight of the sample	47
	6. Tensile strength and elongation	47
	7. Thickness	50

vii

LIST OF FIGURES

1.	Phases of wound healing	3
2.	Wound healing life cycle	5
3.	Chitin chemical structure	8
4.	Chitosan chemical structure	9
5.	Schematic representation of the benefits of chitosan wound dressing	16
6.	Chemical structure for sodium alginate	18
7.	Turmeric	24
8.	Curcumin keto form	25
9.	Curcumin enol form	25
10.	Tridax procumbens	27
11.	Cynodon dactylon	28
12.	Shaker	36
13.	Serial dilution	39
14.	MIC Turmeric	43
15.	MIC Aloe vera	44
16.	MIC Tridax procumbens	44
17.	MIC Cynodon dactylon	45
18.	Tridax procumbens graph	48
19.	Aloe vera graph	49
20.	Turmeric graph	49
21.	Cynodon dactylon	50

viii

- Penetration wounds, caused by an object such as a knife entering and coming out from the skin.

1.2.2. CLOSED WOUNDS

Closed wounds have fewer categories, but are just as dangerous as open wounds. The types of closed wounds are:

- Contusions, more commonly known as bruises, caused by a blunt force trauma that damage tissue under the skin.
- Hematomas, also called a blood tumor, caused by damage to a blood vessel that in turn causes blood to collect under the skin.
- Crush injury, caused by a great or extreme amount of force applied over a long period of time.
- Chronic and Acute or traumatic wounds are the result of injuries that disrupt the tissue. Chronic wounds are those that are caused by a relatively slow process that leads to tissue damage. Chronic wounds include pressure, venous, and diabetic ulcers.

1.3. WOUND HEALING

Wound healing, or wound repair, is an intricate process in which the skin (or another organ-tissue) repairs itself after injury. In normal skin, the epidermis (outermost layer) and dermis (inner or deeper layer) exists in steady-state equilibrium, forming a protective barrier against the external environment. Once the protective barrier is broken, the normal (physiologic) process of wound healing is immediately set in motion.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO WOUND DRESSING

DEFINITION OF WOUNDS

A wound is a type of physical trauma wherein the skin is torn, cut or punctured to create an open wound or where blunt force trauma causes a contusion to create a closed wound. In pathology, a wound specifically refers to a sharp injury which damages the dermis of the skin.

1.2. CLASSIFICATION

1.2.1. OPEN WOUNDS

Open wounds can be classified according to the object that caused the wound. The types of open wound are:

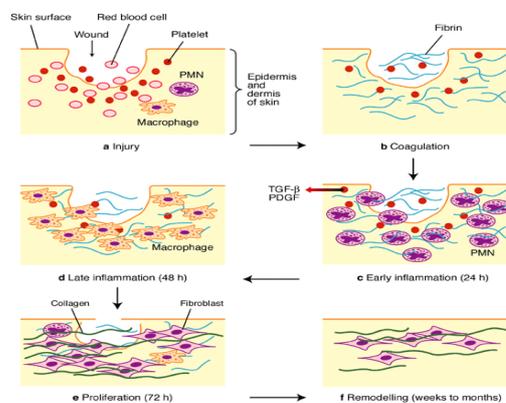
- Incisions or incised wounds, caused by a clean, sharp-edged object such as a knife, a razor or a glass splinter.
- Lacerations, irregular tear-like wounds caused by some blunt trauma. Lacerations and incisions may appear linear (regular) or stellate (irregular). The term laceration is commonly misused in reference to incisions.
- Abrasions (grazes), superficial wounds in which the topmost layer of the skin (the epidermis) is scraped off. Abrasions are often caused by a sliding fall onto a rough surface.
- Puncture wounds, caused by an object puncturing the skin, such as a nail or needle.

1

1.4. PHASES OF WOUND HEALING

1.4.1. INFLAMMATORY PHASE

Just before the inflammatory phase is initiated, the clotting cascade takes place in order to obtain hemostasis, or stop blood loss by way of a fibrin clot. Thereafter, various soluble factors (including chemokines and cytokines) are released to attract cells that phagocytise debris, bacteria, and damaged tissue, in addition to releasing signaling molecules that initiate the proliferative phase of wound healing.



The phases of cutaneous wound healing

Fig 1. 1. Phases of wound healing

1.4.2. PROLIFERATIVE PHASE

About two or three days after the wound occurs, fibroblasts begin to enter the wound site, marking the onset of the proliferative phase even before the inflammatory phase has ended. As in the other phases of wound healing, steps in the proliferative phase do not occur in a series but rather partially overlap in time.

1.4.3. CONTRACTION

Contraction is a key phase of wound healing. If contraction continues for too long, it can lead to disfigurement and loss of function. Thus there is a great interest in understanding the biology of wound contraction, which can be modeled in vitro using the collagen gel contraction assay or the dermal equivalent model. Contraction commences approximately a week after wounding, when fibroblasts have differentiated into myofibroblasts in full thickness wounds, contraction peaks at 5 to 15 days post wounding.

1.4.4. MATURATION AND REMODELING

When the levels of collagen production and degradation equalize, the maturation phase of tissue repair is said to have begun. During maturation, type III collagen, which is prevalent during proliferation, is gradually degraded and the stronger type I collagen is laid down in its place. Originally disorganized collagen fibers are rearranged, cross-linked, and aligned along tension lines. The onset of the maturation phase may vary extensively, depending on the size of the wound and whether it was initially closed or left open, ranging from approximately 3 days to 3 weeks. The maturation phase can last for a year or longer, similarly depending on wound type.

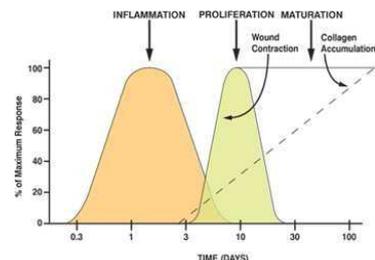


Fig 1. 2. Wound healing life cycle

1.5. CHITOSAN

Chitosan has been found to have an acceleratory effect on wound healing process due to its excellent antimicrobial, biodegradability, biocompatibility and physio-chemical characteristics.

1.6 SODIUM ALGINATE

Alginate exists widely in brown seaweeds, acting as a reinforcing element for cell walls. These fibres have unique gel forming characteristics: Upon contact with wound exudates, the sodium ions in the wound exudates can exchange with the calcium ions in the fibres and as more and more sodium ions enter the fibre structure, the fibres absorb more and more water and form a gel. The gelled structure helps to keep a moist interface between the dressing and the wound surface, which can assist the healing process.

1.7 ALOE VERA

Aloe vera is a species of succulent plant that probably originated in northern Africa. The species is frequently cited as being used in herbal medicine since the beginning of the first century AD. Extracts from Aloe vera are widely used in the cosmetics and alternative medicine industries, being marketed as variously having rejuvenating, healing or soothing properties.

1.8 TURMERIC

Turmeric (*Curcuma longa*) is a rhizomatous herbaceous perennial plant of the ginger family. When not used fresh, the rhizomes are boiled for several hours and then dried in hot ovens, after which they are ground into a deep orange-yellow powder commonly used as a spice. Turmeric is famous for its potential value in traditional medicine. Phytochemicals found in turmeric have been investigated in preliminary research for their potential effects on diseases, such as cancer, arthritis, diabetes and other clinical disorders. Research activity into curcumin and turmeric is increasing.

1.9 TRIDAX PROCUMBENS

Tridax procumbens is a species of flowering plant in the daisy family. It is best known as a widespread weed and pest plant. *Tridax procumbens* is known for several potential therapeutic activities like antiviral, anti oxidant antibiotic efficacies, wound healing activity, insecticidal and anti-inflammatory activity. Some reports from tribal areas in India state that the leaf juice can be used to cure fresh wounds, to stop bleeding, as a hair tonic.

1.10 CYNODON DACTYLON

Cynodon dactylon also known as dūrvā grass, Bermuda grass, bermudagrass, dubo, dog's tooth grass, Bahama grass, devil's grass. It is reported to have serum glucose-lowering and antidiabetic effects, antimicrobial and antiviral properties, and has been suggested for treatment of urinary tract infections, prostatitis, syphilis, and dysentery. *C. dactylon* involving its glycemic potential, which is involved in the treatment of diabetes.

CHAPTER 2

LITERATURE REVIEW

2.1. CHEMICAL AND BIOLOGICAL PROPERTIES OF CHITOSAN

Chitosan is a polysaccharide which is derived from chitin. Chitin is the second most abundant polysaccharide in the world, dominated only by cellulose. Chitin has a homogeneous chemical structure made up of 1-4 linked 2-acetamido-2-deoxy- β -D-glucopyranose. Although chitin is found naturally in large amounts through many sources, chitosan is only found in some fungi with limited quantities. Chitosan is the form of chitin which has been deacetylated to at least 50% of the free amine form, which has a heterogeneous chemical structure made up of both 1-4 linked 2-acetamido-2-deoxy- β -D-glucopyranose as well as 2-amino-2-deoxy- β -D-glucopyranose.

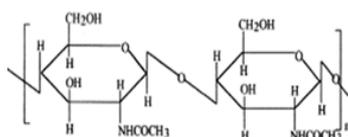


Fig 2.1. Chitin chemical structure

8

2.2. METHOD OF MANUFACTURE AND PHYSICOCHEMICAL PROPERTIES:

It is manufactured by chemically treating the shells of crustaceans such as shrimps and crabs. The process involves separation of proteins by treating with alkali and minerals such as calcium carbonate and calcium phosphate by treatment with acid.

Initially the shells are deproteinized by treatment with (3-5%) aqueous sodium hydroxide solution. The resulting product is neutralized and calcium is removed by treatment with (3-5%) aqueous Hydrochloric acid solution at room temperature to precipitate chitin. The chitin is dried and deacetylated to give chitosan. This can be achieved by treatment with 40-45% aqueous sodium hydroxide solution at moderate temperature (110 C) and the precipitate is washed with water. The crude sample is dissolved in 2% acetic acid and the insoluble material is removed. The resulting clear supernatant solution is neutralized with aqueous sodium hydroxide to give a white precipitate of chitosan. It can be further purified and ground to a fine uniform powder or granules.

Cps= centipoise, ppm= parts per million

Characteristics of pharmaceutical grade chitosan

Parameters	Description
Powder or flake	A white or yellow
Particle size	< 30 μ g
Density	1.35- 1.40 g/cm ³
Ph	4.5 to 7.5
Moisture content	> 10%
Residue on ignition	< 0.2%

10

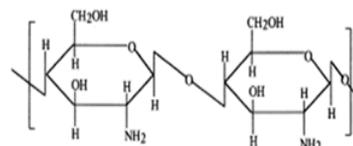


Fig 2.2.Chitosan chemical structure

The properties of chitosan are greatly affected by the conditions under which it is processed, because it is the process conditions that control the amount of deacetylation that occurs. The degree of deacetylation controls the amount of free amino groups in the polymer chain. The free amino groups give chitosan its positive charge. The amino group along with the hydroxyl group gives chitosan its functionality which allows it to be a highly reactive polysaccharide. Chitosan's positive charge allows it to have many electrostatic interactions with negatively charged molecules. The processing conditions as well as the amount of functional groups created by deacetylation allow for side group attachment, which then effects crystallinity which directly relates to chitosan's ability to solubilize in acidic aqueous solutions, which is an important aspect of chitosan's processability. Chitosan has many physicochemical (reactive OH and NH₂ groups) and biological (biocompatible, biodegradable) properties that make it an attractive material for use in various applications. These properties include: biodegradability, lack of toxicity, anti-fungal effects, wound healing acceleration, and immune system stimulation.

9

Protein content	< 0.3%
Degree of deacetylation	70% -100%
Viscosity	< 5 cps
Insoluble matter	< 0.5%
Chloride	10-20%
Heavy metals (As)	< 10 ppm,
Heavy metals (Pb)	< 10-ppm,
Sulphated ash	\leq 1.0%
Glass transition temperature	203° C
Loss on drying	\leq 10 %

A. Niederhofer and B.W. Muller have modified the common method for the preparation of chitosan. From low molecular weight fungi, with an average molecular weight of 4.5×10^4 g/mol and a numerical weight of 1.7×10^4 g/mol, it can be directly extracted from the raw material without the need of thermal or chemical polymerization. Based on the solubility of low molecular chitosan up to alkaline pH ranges, re-precipitation and washing with ethanol is required to keep the low molecular fraction with in the preparation. The use of water for washing between the preparation steps would cause solving and discarding the low molecular chitosan.

11

2.3. MOLECULAR WEIGHT AND DEGREE OF DEACETYLATION:

The molecular weight of chitosan ranges from 1×10^5 to 3×10^5 , whereas average molecular weight ranges from 3.8×10^3 to 2000×10^3 . Degree of acetylation of chitosan ranges from 66% to 99.8%.

2.4. SOLUBILITY:

Chitosan is sparingly soluble in water, practically insoluble in ethanol (95%), other organic solvents and neutral and alkaline solutions at pH above 6.5. It dissolves readily in dilute and concentrated solution of most organic acids and to some extent in mineral inorganic acids. Upon dissolution, group of the polymer becomes protonated, resulting in a positively charged polysaccharide (RNH_3^+) and chitosan salts (chloride, glutamate etc) that are soluble in water. The solubility is affected by degree of deacetylation. Solubility is also influenced by the addition of the salt to the solution. The higher the ionic strength, the lower is the solubility which is due to the result of a salting out effect, which leads to the precipitation of chitosan in solution. When chitosan is in solution, the repulsion between the deacetylated units and their neighbouring glucosamine units causes it to exit in an extended conformation. Addition of an electrolyte reduces this effect and the molecule possesses a more random, coil-like conformation.

12

2.6. CATIONIC POLYAMINE:

Chitosan has high charge density at pH 6.5. Positive charge of chitosan interacts strongly with negative surface such as mineral oil carrying negative charge. It forms gel with number of multivalent ions at low pH range and also with glutaraldehyde and chelates certain heavy transition metals ions by residual amino group. It is used in controlled release technology because of its ionic character along with reactive functional group.

2.7. APPLICATION OF CHITOSAN

2.7.1 PHARMACEUTICAL APPLICATIONS

Direct compressible excipients and as binder:

Chitosan has an excellent property as excipients for direct compression of tablets where the additions of 50% chitosan result in rapid disintegration. The degree of deacetylation determine the extent of moisture absorption. Chitosan higher than 5%, was superior to corn starch and microcrystalline cellulose as a disintegrant. The efficiency was dependent on chitosan crystallinity, degree of deacetylation, molecular weight and particle size. Chitosan is found to be excellent tablet binder as compared to other excipients with the rank order co-relation for binder efficiency. Hydroxy propyl methyl cellulose > chitosan > Methyl cellulose > Sodium carboxy methyl cellulose.

2.7.2. CONTROLLED RELEASE DOSAGE FORMS:

Chitosan and chitosan derivatives, in combination with other excipients are used to give zero-order release profile. The rate of release of drug from tablet was

14

2.5. VISCOSITY (DYNAMIC):

A wide range of viscosity types are commercially available, owing to its high molecular weight and linear, unbranched structure, chitosan is an excellent viscosity-enhancing agent in an acidic environment. It acts as a pseudoplastic material exhibiting a decrease in viscosity with increasing rate of shear. Viscosity of chitosan solution increases with increasing chitosan concentration, decreasing temperature and increasing degree of deacetylation.

Acid	1% concentration		5% concentration		10% concentration	
	Viscosity (cps)	PH	Viscosity (cps)	PH	Viscosity (cps)	PH
Acetic	260	.41	260	3.3	260	2.9
Adepic	190	4.1	--	--	--	--
Citric	35	3.0	195	2.3	215	2.0
Formic	240	2.6	185	2.0	185	1.7
Lactic	235	3.3	235	2.7	270	2.1
Malic	180	3.3	205	2.3	220	2.1
Malonic	195	2.5	--	--	--	--
Oxalic	12	1.8	100	1.1	100	0.8
Tartaric	52	2.8	135	2.0	160	1.7

Typical viscosity (dynamic) values for chitosan 1%w/v solution in different acids

13

found to some degree, to be directly related to the amount and type of chitosan used. Miyazaki et al, who found that, addition of sodium alginate to the tablet preparation gave the tablet an extended release property. Similar results had been found by Kawashima et al, who suggested that citric acid can gel the chitosan and thereby impart sustained release properties.

2.7.3. WOUND HEALING PROPERTIES

Efficacy of chitosan in the promotion of wound healing was first reported in 1978. Chitosan acetate films, which were tough and protective, had the advantage of good oxygen permeability, high water absorptivity and slow enzymatic degradation, thereby avoiding the need for repeated application.

Malette et al showed that treating various dock tissues with chitosan solutions resulted in the inhibition of fibroplasias with enhanced tissue regeneration. 3M Company has marketed Tegaserb™ a wound-healing product for human use, containing chitosan as excipients.

2.7.4 RHEOLOGICAL BEHAVIOUR OF CHITOSAN

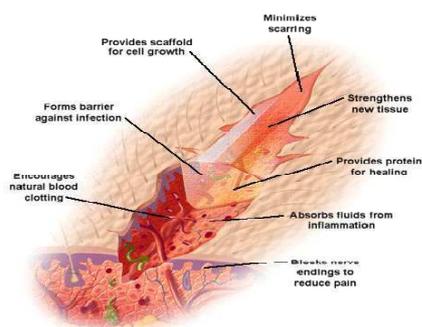
The study examined the influence of temperature, concentration, shearing time, and storage time on the rheological properties, i.e. the dynamic viscosity and shear stress, as a function of shear rate of chitosan solubilized in weakly acid solutions. The results showed that shear thinning behavior (pseudoplastic non-Newtonian behavior) was pronounced at temperatures from 20 to 50o C, but was more remarkable at lower temperature. Chitosan solutions in acetic acid were found to obey the Arrhenius equation. In addition, chitosan in acetic acid solutions exhibited less shear thinning and an increase in viscosity with increasing concentration. This study has also shown that curves of the dynamic viscosity of chitosan solutions show similar behavior at all shearing times of 15-75 s and that

15

less shear thinning behavior and higher values of viscosity of chitosan solutions were observed when the storage period was extended to 3 months. A general increase in viscosity with time was also observed at a constant shear rate, suggesting rheopecty behavior. However, a drop in viscosity was recorded in the fourth month .

2.8 ADVANTAGES OF CHITOSAN WOUND DRESSING MATERIALS

Chitosan is a natural biopolymer that is derived from chitin, a major component of crustacean outer skeletons. This material is known in the wound management field for its haemostatic properties. Further, it also possesses other biological activities and affects macrophage function that helps in faster wound healing. It also has an aptitude to stimulate cell proliferation and histoarchitectural tissue organization. The biological properties including bacteriostatic and fungistatic properties are particularly useful for wound treatment.



16

Fig 2.3 Schematic representation of the benefits of chitosan wound dressing

It showed that chitosan facilitated rapid wound re-epithelialization and the regeneration of nerves within a vascular dermis. Treatment with chitin and chitosan demonstrated a substantial decrease in treatment time with minimum scar formation on various animals. From the different studies reported in literature chitosan seems to be an excellent candidate dressing material for the wound healing applications .

2.9. ANTIMICROBIAL ACTIVITY OF CHITOSAN

In addition to the requirements for wound healing, it is important to control any infection of a wound under dressing. Infectious organisms preferentially target wounds beneath the dressing materials and elicit serious infections that frequently require removal of the wound dressing. For these reasons, the treatment of wounds requires the suppression of bacterial growth. Chitosan has been shown to provide inhibition of bacterial proliferation in the treatment of infected wounds. The antimicrobial activity of chitosan has been recognized against several bacteria and fungi, and is influenced by a number of factors that include the type of chitosan, the degree of polymerization and some of its other chemical and physical properties .

2.10 SODIUM ALGINATE AND ITS HEMOSTATIC PROPERTIES

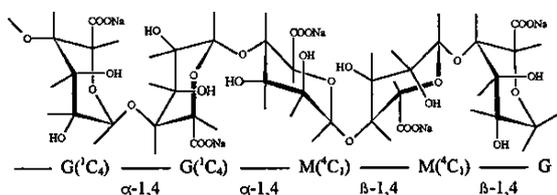
SODIUM ALGINATE

Alginate was first produced from seaweed in 1940. It is a product of a neutralizing reaction between alginic acid and caustic soda. It is non-flammable. When combined with other fibres, it take on a sheer appearance. The raw material for the

17

production of calcium alginate fibres is alginic acid, a compound that is obtained from the marine brown algae. The first scientific reports on the extraction of alginates from brown algae were presented towards the close of the nineteenth century by the chemist E.C.Stanford. He observed that alginates possess a variety of properties, including the ability to stabilize viscous suspensions, to form film layers, and to turn into gels. Chemically, alginate is a polymeric acid, compound of to monomeric units.

- i. L-guluronic acid(G)
- ii. D-mannuronic acid(M)



Chemical structure for sodium alginate

The number and sequence of the manuronate and glucuronate residues shown above vary in the naturally occurring alginate.

Alginates are extracted from brown seaweed and are available in sodium, ammonium and potassium derivatives. They are soluble in both hot and cold water ,

18

and the thicken and bind. In the presence of calcium and an acid some alginates can form resilient gels.

The chemical compound sodium alginate is the sodium salt of alginic acid. It's a form of a gum, when extracted from the cell walls of brown seaweed is used in food industry to increase viscosity and as an emulsifier . It is also used in indigestion tablets. Sodium alginate has no discernible flavor.

Sodium alginate works as a cold gelling agent that needs no heat to gel. It gels in the presence of calcium compounds . Most commonly used with calcium chloride to make caviar and spheres. It dilutes while cold with strong agitation . Heat is not needed to produce spherification. Sodium alginate can also be used to produce foams.

Application

The uses of alginates are based on three main properties. The first is their ability, when dissolved in water, to thicken the resulting solution (more technically described as their ability to increase the viscosity of aqueous solution). The second is their ability to form gels; gels form when a calcium salt is added to a solution of sodium alginate in water. The gels form by chemical reaction , the calcium displace the sodium from the alginate, hold the long alginate molecules together and gel is the result. No heat is required and the gel do not melt when heated. This is in contrast to the agar where gels where the water must be heated to about 80° to dissolve the agar and the gel forms when cooled below about 40°. the third property of alginate is the ability to form films of sodium or calcium alginate and fibers of calcium alginate.

Alginate molecules are long chain that contain two different acidic components, abbreviated here for simplicity to M and G. the way in which these M and G units

19

are arranged in the chain and the overall ratio, M/G, of the two units in a chain can vary from one species of seaweed to another. In other words all "alginate" are not necessarily the same. So some seaweed may produce an alginate that give a high viscosity when dissolve in water, other may a low viscosity alginate. The condition of extraction producer can affect the viscosity, lowering if it condition are too severe. All of this result in seller normally offering a range of alginate with different viscosities.

Similarly, the strength of the gel formed by the addition of calcium salt can vary from one alginate to another. Generally alginate with a higher content of G will give strong gel; such alginate are said to have a low M/G ratio. Good quality stable fiber have been produced from mixed salt of sodium and calcium alginate, and processed into non-woven fabric that is used in wound dressing. They have very good wound healing and haemostatic properties and can be absorbed by body fluids because the calcium in the fiber is exchanged for sodium from the body fluid to give a sodium alginate. This also makes it easy to remove these dressing from large open wound or burns since they do not adhere to the wound. Removal can be assisted by applying saline solution to the dressing to ensure its conversion to soluble sodium alginate. Recently, the consumer division of a multinational pharmaceutical company launched a new line of adhesive bandage and gauze pads based on calcium alginate fibers. They are being promoted as helping blood to clot faster-twice as fast as their older, well established product.

ALGINATE DRESSING

Alginate dressing are manufactured from different varieties of seaweed (used for many generation by sailors as dressing for wound). Alginic acid consist of a polymer containing mannuronic and guluronic residues. Alginates rich in

20

controlled released of AgSD from the sponge matrix of AgSD medicated wound dressing. In vivo tests showed that granulation tissue formation and wound contraction for the AgSD pulsed dihydroepiandrosterone (DHEA) impregnated PEC wound dressing were faster than any other groups.

Alginate is a natural polymer composed of two monomers, ie, L-guluronic acid and D-mannuronic acid. Figure 1 shows the chemical structures of these two monomers and the GG, MM and MG sequences in the polymer chain. Alginic acid consists of two monomers, D-mannuronic acid (M) and L-guluronic acid (G). The relative proportion of mannuronic to guluronic acid in alginate fibre significantly affects the properties of the end product.

Alginate exists widely in brown seaweeds, acting as a reinforcing element for cell walls. These fibres have unique gel forming characteristics: Upon contact with wound exudates, the sodium ions in the wound exudates can exchange with the calcium ions in the fibres and as more and more sodium ions enter the fibre structure, the fibres absorb more and more water and form a gel. The gelled structure helps to keep a moist interface between the dressing and the wound surface, which can assist the healing process.

2.11 ALOE-VERA

Aloe vera is a stemless or very short-stemmed succulent plant growing to 60–100 cm (24–39 in) tall, spreading by offsets. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on the upper and lower stem surfaces. The margin of the leaf is serrated and has small white teeth. The

22

mannuronic acid (like sorbasn) from soft, flexible gel, whereas those which are rich in auluronic acid (like kaltostat) from firmer gels. Some dressing contain calcium alginate fiber (sorbasn and tegagen) and other contain sodium – calcium alginate fiber (sorbasn, kaltostat and kaltgel).

Alginate are suitable for use on medium to heavy exuding wound and cavities. They are not the dressing of choice for infected wound and should not be applied to dry or drying wound, eg, necrotic tissue. Most alginate (except sorbasnplus)require a secondary dressing.

COMBINATION OF CHITOSAN AND SODIUM ALGINATE IN WOUND DRESSING

Drug-impregnated polyelectrolyte complex (PEC) sponge composed of chitosan and sodium alginate was prepared for wound dressing application. The morphological structure of this wound dressing was observed to be composed of a dense skin outer layer and a porous cross section layer by scanning electron microscope. Equilibrium water content and release of silver sulfadiazine could be controlled by number of repeated in situ PEC reaction between chitosan and sodium alginate. The release of AgSD from AgSD-impregnated PEC wound dressing in PBS buffer pH=7.4 was dependent on the number of repeated in situ complex formations for the wound dressing. The anti bacterial capacity of AgSD impregnated wound dressing was examined in agar platem against *Pseudomonas* and *Staphylococcus aureus*. From the behavior of antimicrobial release and the suppression of bacterial proliferation, it is thought that the PEC wound dressing containing antimicrobial agents could protect the wound surfaces from bacterial invasion and effectively suppress bacterial invasion and effectively suppress bacterial proliferation. In the Cytotoxicity test, cellular damage was reduced by the

21

flowers are produced in summer on a spike up to 90 cm (35 in) tall, each flower being pendulous, with a yellow tubular corolla 2–3 cm (0.8–1.2 in) long. Like other Aloe species, Aloe vera forms arbuscular mycorrhiza, a symbiosis that allows the plant better access to mineral nutrients in soil.

Uses

Folk medicine

Early records of Aloe vera use appear in the Ebers Papyrus from 16th century BC, in both Dioscorides' *De Materia Medica* and Pliny the Elder's *Natural History* written in the mid-first century AD along with the *Juliana Anicia Codex* produced in 512 AD. The species is used widely in the traditional herbal medicine of many countries. Aloe vera, called *kathalai* in Ayurvedic medicine, is used as a multipurpose skin treatment. This may be partly due to the presence of saponin, a chemical compound that acts as an anti-microbial agent.

Preliminary research

Aloe vera may be effective in the treatment of wounds. Evidence on the effects of its sap on wound healing, however, is limited and contradictory. Some studies, for example, show that aloe vera promotes the rates of healing, while, in contrast, other studies show that wounds to which aloe vera gel was applied were significantly slower to heal than those treated with conventional medical preparations. A 2007 review concluded that the cumulative evidence supports the use of aloe vera for the healing of first to second degree burns. Topical application of aloe vera may also be effective for genital herpes and psoriasis. However, it is not effective for the prevention of radiation-induced injuries.

23

2.12 TURMERIC

Turmeric has been used in India for thousands of years and is a major part of Ayurvedic medicine. It was first used as a dye and then later for its possible medicinal properties



Phytochemicals found in turmeric have been investigated in preliminary research for their potential effects on diseases, such as cancer, arthritis, diabetes and other clinical disorders. As an example of such basic research, turmeric reduced the severity of pancreatitis-associated lung injury in mice.

According to one report, research activity into curcumin and turmeric is increasing. The U.S. National Institutes of Health currently has registered 71 clinical trials completed or underway to study use of dietary curcumin for a variety of clinical disorders .

24



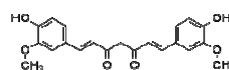
☞

Turmeric rhizome

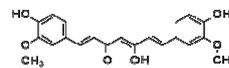
Some research shows compounds in turmeric to have anti-fungal and anti-bacterial properties; however, curcumin is not one of them.

In another preliminary research example, curcumin is being studied for whether it alters the response to chemotherapy in patients with advanced bowel cancer, as found in a laboratory study.

Composition



Curcumin keto form



Curcumin enol form

25

Turmeric contains up to 5% essential oils and up to 5% [dubious – discuss] curcumin, a polyphenol. Curcumin is the active substance of turmeric and curcumin is known as C.I. 75300, or Natural Yellow 3. The systematic chemical name is (1E,6E)-1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione.

It can exist at least in two tautomeric forms, keto and enol. The keto form is preferred in solid phase and the enol form in solution. Curcumin is a pH indicator. In acidic solutions (pH <7.4) it turns yellow, whereas in basic (pH > 8.6) solutions it turns bright red.

2.13 TRIDAX PROCUMBENS

Description

The plant bears daisylike yellow-centered white or yellow flowers with three-toothed ray florets. The leaves are toothed and generally arrowhead-shaped. Its fruit is a hard achene covered with stiff hairs and having a feathery, plumelike white pappus at one end. Calyx is represented by scales or reduced to pappus. The plant is invasive in part because it produces so many of these achenes, up to 1500 per plant, and each achene can catch the wind in its pappus and be carried some distance. This weed can be found in fields, meadows, croplands, disturbed areas, lawns, and roadsides in areas with tropical or semi-tropical climates.

26



☞

uses

Tridax procumbens is known for several potential therapeutic activities like antiviral, anti oxidant antibiotic efficacies, wound healing activity, insecticidal and anti-inflammatory activity. Some reports from tribal areas in India state that the leaf juice can be used to cure fresh wounds, to stop bleeding, as a hair tonic. Despite these known benefits, it is still listed in the United States as a Noxious Weed and regulated under the Federal Noxious Weed Act.

2.14 CYNADON DACTYLON

The blades are a grey-green colour and are short, usually 2–15 cm (0.79–5.9 in) long with rough edges. The erect stems can grow 1–30 cm (0.39–12 in) tall. The stems are slightly flattened, often tinged purple in colour. The seed heads are produced in a cluster of two to six spikes together at the top of the stem, each spike 2–5 cm (0.79–2.0 in) long. It has a deep root system; in drought situations with penetrable soil, the root system can grow to over 2 m deep, though most of the root mass is less than 60 cm under the surface.

27



Use in alternative medicine

C. dactylon has been studied at the University of Allahabad in India, and is reported to have serum glucose-lowering and antidiabetic effects, antimicrobial and antiviral properties, and has been suggested for treatment of urinary tract infections, prostatitis, syphilis, and dysentery. Additional research is being conducted on *C. dactylon* involving its glycaemic potential, which is involved in the treatment of diabetes. In laboratory rats treated with the ethanolic extract of defatted *C. dactylon*, blood glucose levels of the tested population showed nearly a 50% drop when the proper dosage was administered. This suggests the potential for *C. dactylon* to become an alternative to current diabetes medications.

28

second just like breathing. Such a garment makes people feel extremely cool, comfortable and never sticking to skin even in hot summer.

- 100% bamboo yarns show a great elasticity i.e. nearly 20%. Even in 100% bamboo woven fabrics a remarkable elasticity can be obtained wherein the use of elastomeric fibres like elastanes may be eliminated.
- Bamboo fabrics need less dyestuff than cotton, modal or viscose. It seems that the absorption of dyestuffs is remarkably better. Bamboo absorbs the dyestuffs faster and shows the colors better.
- Anti-ultraviolet nature of bamboo fibre has made it suitable for summer clothing, especially for the protection of pregnant ladies and children from the effect of ultraviolet radiation.
- Product of bamboo fibre is eco-friendly and bio-degradable.

End-use

1. Intimate apparels include sweaters, bath-suits, underwear, tight t-shirt, socks.
2. Due to its anti-bacterial nature, non-woven fabric has wide prospects in the field of hygiene materials such as sanitary napkin, masks, mattress, food-packing, bags.
3. Sanitary materials: bandage, mask, surgical clothes, nurses wears and so on. It has incomparably wide foreground on application in sanitary material such as

30

2.15 BAMBOO FABRIC AND ITS PROPERTIES

Bamboo fibre is a regenerated cellulosic fibre produced from bamboo. Starchy pulp is produced from bamboo stems and leaves through a process of alkaline hydrolysis and multi-phase bleaching. Further chemical processes produce bamboo fibre.

Repeated technological analysis has proved that this kind of fibre has a thinness degree and whiteness degree close to normal finely bleached viscose and has a strong durability, stability and tenacity.

Bamboo fibre fabric is made of 100% bamboo pulp fibre. It is characterized by its good hygroscopicity, excellent permeability, soft feel, easiness to straighten and dye and splendid color effect of pigmentation.

Features

- Softer than cotton, with a texture similar to a blend of cashmere and silk.
- Because the cross-section of the fibre is filled with various micro-gaps and micro-holes, it has much better moisture absorption and ventilation. Moisture absorbency is twice than that of cotton with extraordinary soil release.
- Natural antibacterial elements (bio-agent "bamboo kun") in bamboo fibre keep bacteria away from bamboo fabrics.
- Garment of bamboo fibre can absorb and evaporate human sweat in a split of

29

sanitary towel, gauze mask, absorbent pads, and food packing.

4. Decorating items: curtain, television cover, wall-paper and sofa slipcover.

5. Bathroom products: towel and bath robe

Compared with other textiles, bamboo fibre has the following advantages:

Natural anti-bacteria

It is a common fact that bamboo can thrive naturally without using any pesticide. It is seldom eaten by pests or infected by pathogen. Why? Scientists found that bamboo owns a unique anti-bacteria and bio-agent named "bamboo Kun". This substance combined with bamboo cellulose molecular tightly all along during the process of being produced into bamboo fibre.

Bamboo fibre has particular and natural functions of anti-bacteria, bacteriostasis and deodorisation. It is validated by Japan Textile Inspection Association that, even after fifty times of washing, bamboo fibre fabric still possesses excellent function of anti-bacteria, bacteriostasis. Its test result shows over 70% death rate after bacteria being incubated on bamboo fibre fabric. Bamboo fibre's natural anti-bacteria function differs greatly from that of chemical antimicrobial. The latter often tend to cause skin allergy when added to apparel.

Breathable and cool

What is notable of bamboo fibre is its unusual breathability and coolness. Because

31

the cross-section of the bamboo fibre is filled with various micro-gaps and micro-holes, it has much better moisture absorption and ventilation. With this unparalleled micro-structure, bamboo fibre apparel can absorb and evaporate humans sweat in a split second. Just like breathing, such garments make people feel extremely cool and comfortable in the hot summer. It is never sticking to skin even in hot summer. According to authoritative testing figures, apparels made from bamboo fibres are 1-2 degrees lower in temperature than normal

apparels in hot summer. Apparel made from bamboo fibre is crowned as air-conditioning dress.

Green & biodegradable

As a regenerated cellulose fibre, bamboo fibre was 100% made from bamboo through high-tech process. The raw material bamboo is well-selected from non-polluted region. They are all 3-4 year old new bamboo, of good character and ideal temper. The whole distilling and producing process in our plant is green process without any pollution. Most of the companies manufacture bamboo fibre strictly according to ISO 9000 and ISO 14000. They produce natural and eco-friendly fibre without any chemical additive.

What is more, bamboo fibre is biodegradable textile material. As a natural cellulose fibre, it can be 100% biodegraded in soil by micro-organism and sunshine. The decomposition process does not cause any pollution environment. "Bamboo fibre comes from nature, and completely returns to nature in the end".

MATERIALS AND METHODS

3.1 FABRIC SPECIFICATIONS

Non woven- Bamboo (spun laid)

GSM – 125

3.2 MATERIALS USED

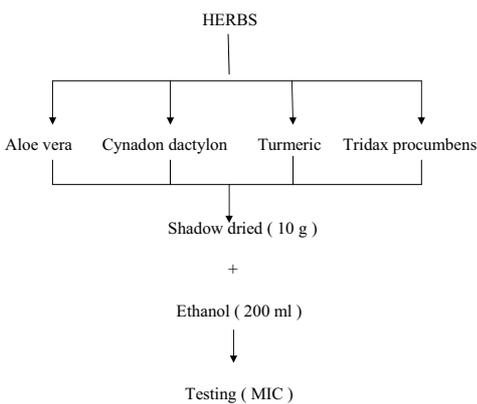
HERBS – Turmeric, Aloe vera , Tridax procumbens , Cynodon dactylon

ETHANOL - SOLVENT

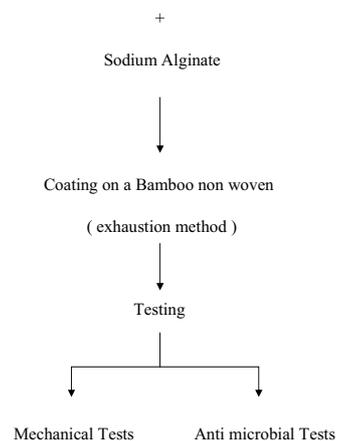
Ethanol, also called ethyl alcohol, pure alcohol, grain alcohol, or drinking alcohol, is a volatile, flammable, colorless liquid. A psychoactive drug and one of the oldest recreational drugs known, ethanol produces a state known as alcohol intoxication when consumed. Best known as the type of alcohol found in alcoholic beverages, it is also used in thermometers, as a solvent, and as a fuel. In common usage, it is often referred to simply as alcohol or spirits.

3.3 METHODOLOGY

3.3.1 STAGE 1 : Extract preparation



3.3.2 STAGE 2 Hydro gel preparation



3.4 PREPARATION OF HERBAL EXTRACT

The leaves were cut into smaller pieces and the leaves which were cut, is air dried for 2 days and pulverized to powder using a blender. The powdered sample of 10 grams was weighed and is placed in a stoppered container with 99% of 100 ml ethanol and allowed to stand at room temperature for 72 hours with frequent agitation until the soluble matter has dissolved. The mixture is then strained, the marc is pressed and the combined liquids are clarified by the filtration. The extract was prepared with DMSO and stored for further use.



SHAKER

3.5 HYDROGEL SYNTHESIS

Preparation of Chitosan – Sodium Alginate Hydrogel

- Step 1 : 0.5 ml of Lactic acid diluted in 35 ml of distilled water.
- Step 2 : 0.5g of chitosan dissolved in 35.5 ml of lactic acid solution and stirred.
- Step 3 : 5 g of sodium alginate is dissolved in 100 ml of distilled water and stirred
- Step 4 : Chitosen along with sodium alginate is stirred together.
- Step 5 : Extract is added to the hydrogel and stirred.

36

methods usually following the guidelines of a reference body such as the CLSI, BSAC, or EUCAST. There are several commercial methods available, including the well established Etest strips and the recently launched Oxoid MIC evaluator method.

3.6.1 MIC test

SERIAL DILUTION

A serial dilution is a step wise dilution of a substance in solution. Usually the dilution factor at each step is constant, resulting in a geometric progression of the concentration in a logarithmic fashion. A ten-fold serial dilution could be 1m, 0.1m, 0.01m, 0.001m... Serial dilution are used to accurately create high diluted solution as well as solutions for experiments resulting in concentration curves with a logarithmic scale. A ten-fold dilution for each step is called a logarithmic dilution or log dilution , a 3.16-fold dilution is called a half-log dilution and 1.78-fold dilution called a quarter log dilution. Serial dilution are widely used in experimental sciences, including biochemistry, pharmacology, microbiology and physics.

In biology and medicine, besides the more conventional uses described above, serial dilution may also be used to reduce the concentration of microscopic organisms or cells in a sample. As, for instance the number and size of bacterial colonies that grow on a agar plate in a given time is concentration-dependent, and since many other diagnostic techniques involve physically counting the number of micro organisms or cells on specials printed with grids (for comparing concentration of two organisms or cell types in the sample) or well of a given volume (for absolute concentration) dilution can be useful for getting more

38

30 ml of extract is added in 100 ml of CH-AL hydrogel (all four extract).

Let us assume,

- S1 – Tridax Procumbens
- S2 – Aloe vera
- S3 – Turmeric
- S4 – Cynadon

EXHAUSTION METHOD

DIP AND DRY METHOD

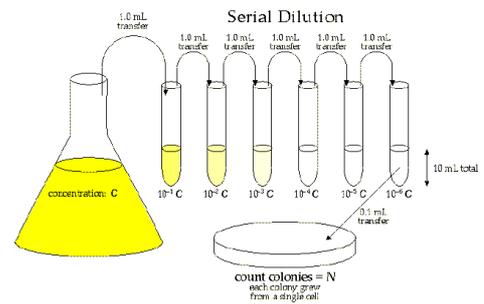
Dip and dry method is the simple and easy way of applying the extract to a fabric. The bamboo fabric is cut into 8 x 8 of several pieces. Then each pieces is dipped in the hydrogel. After dipping in the hydrogel, the sample is taken out and a little squeegee is made. After squeezing the sample is dried for few hours.

3.6 MINIMUM INHIBITORY CONCENTRATION

In microbiology , minimum inhibitory concentration (MIC) is the lowest concentration of an antimicrobial that will inhibit the visible growth of a micro organism after overnight incubation. Minimum Inhibitory Concentration are important in diagnostic laboratories to confirm resistance of microorganism to an antimicrobial agent and also to monitor the activity of new antimicrobial agents. A lower MIC is an indication of a better antimicrobial agent. A MIC is generally regard as the most basic laboratory measurement of the activity of an antimicrobial agent against an organism. MICs can be determined by agar or serial dilution

37

manageable results. Serial dilution is also a cheaper and simple method for preparing cultures from a single cell than optical tweezers and micromanipulators.



3.6.2 ANTIBACTERIAL ACTIVITY

Material Required:

Glass wares – Petri plates, Conical flasks, Boiling tubes, Beakers.

Others – Cotton swab, Antibiotic Disc, Forceps , Sterile discs.

39

ANTIBIOTIC SENSITIVITY TEST

Antimicrobial sensitivity was carried out by disc diffusion method (Bauer et al 1966; NCCLS 1993) against test micro organisms ,which includes Escherichia coli, Staphylococcus aureus, Pseudomonas Bacillus .All the cultures were obtained from Department of microbiology, CMS college. The antibacterial activities were determined using the Agar Disc Diffusion Method with slight modification. Standard antibiotic discs like Penicillin were used. Sterilized filter paper disc made from What man no.1 filter paper (3 mm) impregnated with plant extracts made into a paste like form using DMSO were used. The disc were allowed to absorb the plant extracts.

The culture plates were taken for doing the test. Antibiotic test, Penicillin was kept on the culture plate using sterile forceps. Sterile disc soaked with the plant extract was placed on the culture medium using a sterile forceps. After that the plates were again kept for incubation at 37 C for 24 hours. After incubation , the growth of inhibition to the nearest millimeter from the lower surface of the Petri dishes.

3.6.3 MECHANICAL TEST

WATER UPTAKE

The water uptake was assessed gravimetrically. The weights of the completely dried samples were determined with an analytical balance. Strips of sample (2 x 2 cm²) were immersed in de-ionized water at 37C in an incubator for 24 hours. The resultant swollen sample was gently blotted with filter paper to remove excess surface water and weighed again. The water uptake of the film is the increase in weight , expressed as a percentage.

40

$$\text{Elongation \%} = \text{Increase in length} / \text{original length} \times 100.$$

THICKNESS

A micrometer was used to measure the thickness of the sample with least count of 0.001 mm prior to all the tests. Sample strips in specific dimensions and free from air or bubble or physical imperfection were held between two clamps and the thickness of the sample was measured using a micro meter at five location, and the mean thickness was calculated. Samples with air bubbles, nicks or tears and having mean thickness variation of greater than 5% were excluded from the analysis.

ANTI-ALLERGIC PROPERTY

To determine the anti-allergic property of the sample, contact dermatitis test was performed. Test samples (2.5 x 2.5) were placed on a patch of hair less skin was after 24 hours was assessed visually. Samples which caused itching or rashes were said to have allergic property.

42

The water uptake of different samples was calculated using the following method:

$$\text{Water uptake (\%)} = 100 \times (W2 - W1) / W1$$

Where,

W1 – the weight of the completely dried sample.

W2 – the weight of swelled sample in the different pH buffer solution at 37C for 1 hour.

SURFACE pH

To measure the surface pH, prepared samples were left to swell for 2 hours in doubled distilled water with stirring. The surface pH was measured by means of pH paper (strip) placed on the surface of the swollen sample, the mean of two readings was dually recorded.

TENSILE STRENGTH & ELONGATION

Tensile strength was evaluated using an Instron Universal Testing Instrument. Sample of the required dimension without any air bubble or physical imperfections was held between two clamps positioned at a distance of 3cm. During the measurement , the top clamp was pulled at rate of 100 mm/min and the force and elongation were measured upon the breaking the samples. The results from sample that broke down between the clamps were used.

Measurement were run in triplicate for each sample. Tensile strength and percent elongation were calculated by applying the following equation:

Tensile strength = Force at break (N) / initial cross sectional area of the sample.

41

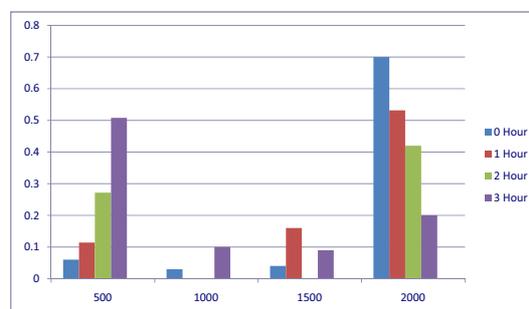
CHAPTER 4

RESULTS AND DISCUSSION

MIC

X axis = $\mu\text{g} / \text{ml}$, Y axis = concentration

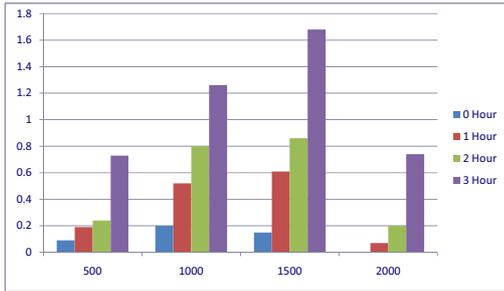
Turmeric



The above graph shows a decrease in the concentration of turmeric at 2000 $\mu\text{g}/\text{ml}$. Initially there was increase in concentration of turmeric but the decrease at 2000 $\mu\text{g}/\text{ml}$ shows that turmeric inhibits the bacteria to a greater extent.

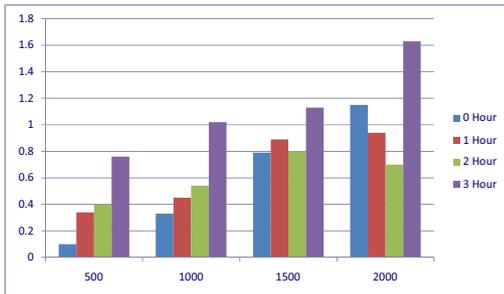
43

Aloe vera



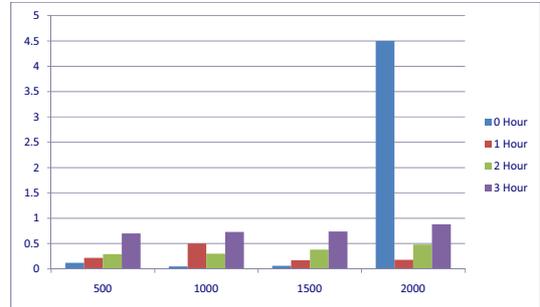
In this graph aloe vera shows a regular increase at all levels. Since there is an increase at all concentration, it doesn't inhibit bacteria much.

Tridax procumbens



Here tridax procumbens shows an irregular change at all levels. Its inhibiting property is oscillating in nature and it also doesn't inhibit bacteria.

Cynodon dactylon



Cynodon dactylon concentration changes at all levels

From the above graphs, it shows that turmeric inhibits the concentration level of bacteria.

ANTI BACTERIAL TEST

DIAMETER OF ZONE INHIBITION (MEAN±SD) in mm

Sample	<i>Staphylococcus aureus</i>	<i>Escherichia Coli</i>	<i>Candida Albicans</i>
S1	3.2±0.06	2.5±0.13	-
S2	2.7±0.03	2.3±0.2	-
S3	3.7±0.08	2.7±0.22	-
S4	2.9±0.09	2.4±0.17	-

The antimicrobial properties are favorable and hence this product can be used in Wound dressings. The results show that turmeric has highest antibacterial property

WATER UPTAKE

	S1	S2	S3	S4
INITIAL WEIGHT (g)	0.07	0.06	0.07	0.06
FINAL WEIGHT (g)	0.36	0.41	0.37	0.32
WATER UPTAKE(%)	441.28	583.33	428.57	433.33
PH	7	7	7	7

The water uptake properties are good which is most essential for wound dressing .the above table shows that aloe vera coated fabric has highest water uptake %.

WEIGHT OF THE SAMPLE (g)

S.NO	S1	S2	S3	S4
1	0.07	0.07	0.07	0.06
2	0.06	0.07	0.07	0.05
3	0.07	0.06	0.07	0.07
4	0.08	0.06	0.07	0.06
AVG	0.07	0.065	0.07	0.06

The weight of all the samples are almost equal .

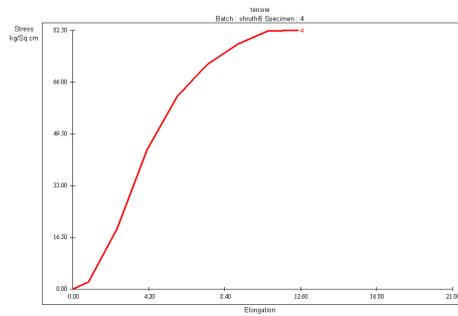
TENSILE STRENGTH AND ELONGATION

S.NO	TENSILE PARAMETERS	S1	S2	S3	S4
1	Maximum load (kg)	10.308	11.706	11.503	11.850
2	Tensile strength (kg/cm)	82.464	93.648	92.02	94.80
3	Elongation (%)	12.48	29.14	14.16	24.09

The sample S4 Cynadon Dactylon can with stand a maximum load and it also has good tensile strength when compared to other samples.

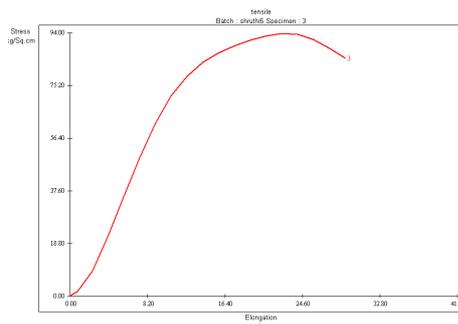
But the sample S2 Aloe vera has a maximum elongation property when compared to others.

S1 – Tridax Procumbens

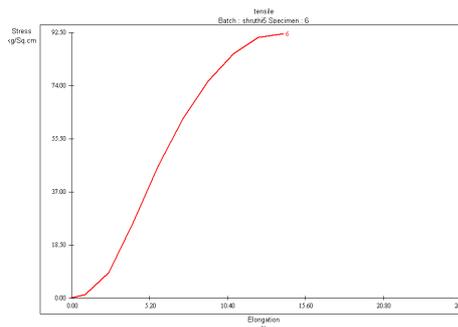


48

S2 – Aloe Vera

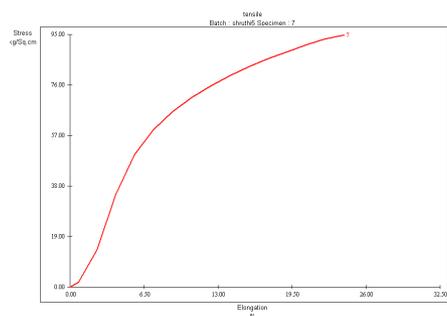


S3 - Turmeric



49

S4 – Cynadon Dactylon



THICKNESS (mm)

S.NO	S1	S2	S3	S4
1	0.053	0.054	0.055	0.056
2	0.051	0.055	0.055	0.055
3	0.050	0.053	0.054	0.057
4	0.051	0.054	0.055	0.056
AVG	0.052	0.053	0.055	0.056

ANTI-ALLERGIC PROPERTY

The test result is **POSITIVE**

50

CHAPTER 5

CONCLUSION

It is concluded that, the herb turmeric showed significant antibacterial activity when compared to other herbs (tridax procumbens, aloe vera and cynadon dactylon). The experimental evidence obtained in the laboratory model could provide a rationale for the traditional use of this plant as antibacterial for wound healing. Thus the present experiments scientifically proved the beneficial effect as an antibacterial for the bacterial infection from hydroalcoholic extract of Turmeric. Turmeric shows the maximum property of inhibition at 2000µg/ml at a time period of 3hrs. The antibacterial test by Agar disc diffusion method also shows that turmeric shows the wider diameter of zone of inhibition compared to other herbs considered (tridax procumbens, aloe vera and cynadon dactylon) The plant may be further explored for its phytochemical profile to recognize the active constituent accountable for antibacterial activity

51

REFERENCE

1. Ragasa C, Laguardia M, Rideout J (2005). "Antimicrobial sesquiterpenoids and diarylheptanoid from *Curcuma domestica*". ACGC Chem Res Comm 18 (1): 21-24.
2. Henrotin Y, Clutterbuck AL, Allaway D, et al. (February 2010). "Biological actions of curcumin on articular chondrocytes". Osteoarthr. Cartil. 18 (2): 141–9.
3. Mahady, GB; Pendland, SL; Yun, G; Lu, ZZ (2002). "Turmeric (*Curcuma longa*) and curcumin inhibit the growth of *Helicobacter pylori*, a group 1 carcinogen". Anticancer Res. 22 (6C): 4179-4181.
4. Chithra P., Sajithlal G.B., Chandrakasan G., Influence of aloe vera on the healing of dermal wounds in diabetic rats J. Ethnopharmacol.,59, 1998;195–201.
5. Kumar B,ijayakumar M, Govindarajan R,Pushpangadan P., "Ethnopharmacological approaches to wound healing—Exploring medicinal plants of India.", J. Ethnopharmacol., 114, 2007; 103–113.
6. Anand Kumar*, Pranita Kashyap, Hemant Sawarkar, Bhusan Muley, Ajit Pandey "Evaluation of Antibacterial Activity of *Cynodon dactylon* (L.) Pers. International Journal of Herbal Drug Research", Vol I, Issue II, 31-35, 2011
7. Ernst E (2000). "Adverse effects of herbal drugs in dermatology". Br J Dermatol 143: 923–929.
8. Boudreau MD, Beland FA (2006). "An Evaluation of the Biological and Toxicological Properties of *Aloe Barbadensis* (Miller), *Aloe Vera*". Journal of Environmental Science and Health Part C 24: 103–154.
9. Vogler BK, Ernst E (Oct 1999). "Aloe vera: a systematic review of its clinical effectiveness". Br J Gen Pract 49 (447): 823–8.
10. Langmead L, Feakins RM, Goldthorpe S, et al. (April 2004). "Randomized, double-blind, placebo-controlled trial of oral aloe vera gel for active ulcerative colitis". Alimentary pharmacology & therapeutics 19 (7): 739–47.
11. Eshun K., He Q (2004). "Aloe Vera: A Valuable Ingredient for the Food, Pharmaceutical and Cosmetic Industries—A Review". Critical Reviews in Food Science and Nutrition 44 (2): 91–96
12. Heggors JP, Elzaim H, Garfield R, et al. (1997). "Effect of the combination of Aloe vera, nitroglycerin, and L-NAME on wound healing in the rat excisional model". Journal of alternative and complementary medicine 3 (2): 149–53
13. Davis RH, Leitner MG, Russo JM, Byrne ME (November 1989). "Wound healing. Oral and topical activity of Aloe vera". Journal of the American Podiatric Medical Association 79 (11): 559–62
14. Bauer AW, Kirby WMM, Sherris JC & Turck M (1966). Antibiotic susceptibility
15. Testing by standardized single disc method. Am J Clin Pathol 36: 493–496.
16. Schmidt JM, Greenspoon JS (July 1991). "Aloe vera dermal wound gel is associated with a delay in wound healing". Obstetrics and gynecology 78 (1): 1157
17. Maenthaisong R, Chaiyakunapruk N, Niruntraporn S et al. (2007). "The efficacy of aloe vera for burn wound healing: a systematic review". Burns 33 (6): 713–718.
18. Cowan MM (1999). "Plant products as antimicrobial agents". Clin Microbiol Rev 12: 564–582.
19. self-assembling hydrophobically modified chitosan capable of reversible hemostatic action Matthew B. Dowling, Rakesh Kumar, Biomaterials 32 ,2011, 3351-3357.
20. New hemostatic agents in the combat setting. E.Darrin cox, martin A Schreiber, john mcmanus, Charles E Wade and john B Holcomb Transfusion vol:49dec 2009 248s-255s
21. Mechanical Behavior of Thru-air Bonded Nonwoven Structures doi: 10.1177/0040517507081313 Textile Research Journal June 2007 vol. 77 no. 6 417-431
22. Wettability and antibacterial assessment of chitosan containing radiation-induced graft nonwoven fabric of polypropylene-g-acrylic acid Jen Ming Yang, Hao Tzu Lin, TeHsing Wu, Chia-Chieh Chen Article first published online: 28 AUG 2003
23. Hemostatic Dressings for the First Responder Kelly King; Marcus C. Neuffer; Jonathan McDivitt; David Rose; Clifford C. Cloonan; Joshua S. Vayer Military Medicine, Volume 169, Number 9, September 2004 , pp. 716-720(5)
24. A review on the application of inorganic nano-structured materials in the modification of textiles: Focus on anti-microbial properties Roya Dastjerdi, Majid Montazer Colloids and Surfaces B: Biointerfaces 79 (2010) 5–18