EXPLORATION OF BIOCOMPOSITE NATURAL WASTE SUGAR CANE (*BAGASSE*) FIBER AS RESTORATION MATERIAL (A SYSTEMATIC REVIEW)

THESIS

Submitted To Hasanuddin University To Complete One Of The Requirements To Achieve A Bachelor's Degree Of Dentistry

BY

ROLAND DEAVID BENYAMIN

J011191024

DEPARTMENT OF CONSERVATIVE DENTISTRY
FACULTY OF DENTISTRY
HASANUDDIN UNIVERSITY

2023

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Hereby declare that the thesis titled "Exploration Of Biocomposite Natural Waste Sugar Cane (Bagasse) Fiber As Restoration Material (A Systematic Review)" is my oen original work, and no plagiarism has been done in its writing. Any citations in this thesis have been given die acknowledgements and have their sources quoted and listed. I am willing to carry out proper process in accordance with the applicable laws and regulations if it turns out that thesis is party or entirely plagiarized from other works.

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Makassar, January 27th 2023

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PREFACE

All praise and gratitude to God Almighty for all His blessings and guidance so that the author can complete the writing and preparation of the thesis titled "Exploration Of Biocomposite Natural Waste Sugar Cane (*Bagasse*) Fiber As Restoration Material (A Systematic Review)" This thesis was written as a requirement for the completion of studies in achieving a bachelor's degree in dentistry at the Faculty of Dentistry, Hasanuddin University. And we always give thanks to the Lord Jesus Christ for the infinite love He gave for the salvation of mankind.

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The author is fully aware that this thesis is still far from perfection, because perfection belongs to Allah alone. Therefore, the author apologizes if there are errors in the writing of this thesis. The author appreciates criticism and suggestions for the improvement of similar writing in the future. The author hopes that this thesis can be useful and can be of positive value for all parties who need it.

Makassar, January 27th 2023

Author

EKSPLORATION BIOCOMPOSITE NATURAL WASTE SUGAR CANE (*BAGASSE*) FIBER AS RESTORATION MATERIAL (A SYSTEMATIC REVIEW)

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ABSTRACT

Background: In recent years, the using of composite resins have been develop, bio-based polymers and monomers derived from renewable biocomposite materials have been increased which important for development of products that could replace products made from petrochemical derivatives. Biocomposite is a type of composite consisting of polymer matrix material and reinforcement made from natural fibers, especially natural waste sugarcane (*bagasse*) fibers. Waste sugar cane (*baggase*) fiber is an organic waste that is mostly produced in cane sugar processing factories in Indonesia. This fiber has quite high economic value besides being a result of sugar cane factory waste, this fiber is also easy to get, inexpensive, does not harmful for health, can be degraded naturally (biodegradability). **Objective:** To explore biocomposite natural waste sugarcane (*bagasse*) fiber as a restorative material. **Methods:** The research design is a systematic review. The articles search were carried out through the search engines PubMed, Research Gate, and Google Scholar in 2012-2022. The keywords entered are: *bagasse* fiber, resin composite, restoration, dentistry. Inclusion and exclusion criteria were made. **Results:** Based on the search, 1,503 articles were obtained, after being excluded, 54 articles that met the criteria were obtained. Of the 54 articles, 49 articles were duplicates, so only 5 articles were obtained for analysis. **Conclusion:** Researchs showed that the addition of *bagasse* fiber to composite resin could improved both physical and mechanical properties of composite resin. The type, size, and position of bagasse fiber were important factors to improving the physical and mechanical properties of the composite resin.

Key Words: Bagasse fiber biocomposite, Restoration, Systematic review.

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CHAPTER I

INTRODUCTION

1.1 Background

In the oral cavity, teeth has an important role as a means of mastication. However, behind this role, tooth decay will have a large enough impact so that it interferes with the process of food mastication which results in a decrease people performance because of the pain felt.[1] Damage to teeth can caused by of caries, attrition, abrasion, erosion and fracture[2] due to the demineralization process metabolic activity of cariogenic bacteria and non-bacterial processes such as chemicals in the form of acids, trauma from impact, even improper tooth brushing techniques causing abnormal mechanical processes in the tooth structure.[3-6]

In Indonesia, dental and oral health are still problems where there are still many cases of dental caries and periodontal diseases with a fairly high prevalence in various provinces.[7] Based on report riset dasar kesehatan (Riskesda) at 2018 regarding oral and dental health in Indonesia, it showed that the proportion of teeth with caries and/or teeth experiencing pain is 45.3%, while the proportion of teeth that were restored only 4.1%[8], so it is concluded that awareness of the importance of prevention and dental and oral care is still very low. This also illustrates that the community's need for dental health facilities and restorative materials is still relatively high.

The most widely used restorative material in dentistry was composite resin due to the ability of this material to produce a color that resembles the color of natural teeth, besides that composite resin was also able to provide a solution to the public's concerns about the hazard using restorative materials containing mercury, namely amalgam.[9,10] The use of composite resin consists of an adhesive system and composite resin as a restorative material. The composition of the composite resin is: (1) Matrix which functions as an organic material, (2) Filler or filler material as an inorganic material, and (3) Coupling agent as a silane.[11,12] The organic matrix was formed by methacrylate monomers which polymerize via free radicals, forming cross-linked networks to obtain materials with high mechanical strength, low polymerization shrinkage, and high conversion of double bonds. The organic matrix in composite resins was generally composed of 2,2-bis[4-(2-hydroxy-3-methacryloyloxypropoxy) phenyl] propane (Bis-GMA) monomer and another low viscosity diluent monomer such as triethylene glycol dimethacrylate (TEGDMA) or aliphatic urethanes dimethacrylates such as urethane dimethacrylate (UDMA).[12]

In recent years, the use of composite resins has began to develop, bio-based polymers and monomers derived from renewable biocomposites have began to increased which was important to development of products that can replace products made from petrochemical derivatives. Biocomposite is a type of composite consisting of polymer matrix material and reinforcement made from natural fibers, especially natural waste sugarcane (*bagasse*) fibers. Waste sugar cane (baggase) fiber is an organic waste that is mostly produced in sugar cane processing factories in Indonesia. This fiber has quite high economic value besides being a waste product of sugar cane factories, this fiber is also easy to get, inexpensive, does not hazard health, could be degraded naturally (biodegradability). The trend of using fiber-reinforced polymer biocomposite technology, especially natural fibers, is gaining interest because it was environmentally friendly so that it could support green dentistry, the availability of raw materials that were abundant in nature, and relatively low production costs.[13]

Based on this background, the authors want to exploration of biocomposite natural waste sugarcane (*bagasse*) fiber as a restorative material through a systematic review approach.

1.2 Formulation of the Problem

How is the exploration biocomposite natural waste sugarcane (*bagasse*) fiber as restorative materials?

1.3 Objectives of Thesis

1. Explore biocomposite natural waste sugarcane (*bagasse*) fiber as a restorative material.
2. Describes the latest development of biocomposite natural waste sugarcane (bagasse) fiber as a restorative material

1.4 Benefit of Thesis

The benefits that can be obtained from this systematic review are :

1. Knowing biocomposite natural waste sugarcane (bagasse) fiber as a restorative material.
2. Provide scientific information to students and dentists regarding biocomposite natural waste sugarcane (bagasse) fiber as a restorative material.
3. The results of the research can be used as reference for future research on biocomposite materials of natural waste sugarcane (bagasse) fibers.

CHAPTER II

LITERATURE REVIEW

2.1 Restoration Tooth

Damage that occurs in the tooth structure will cause problems due to the function of the teeth in mastication, speaking, and maintaining facial shape. For this reasons, it was important to maintain healthy teeth as early as possible so that they could last a long time in the oral cavity.[14] Treatment for dental caries depends on the degree of tooth decay. Dental restorations were performed by placing materials on the prepared teeth so the physiological and mechanical functions, anatomical shape, occlusion, contact points, and aesthetics of the restored teeth can be maintained.[15]

Initially dental restoration materials used amalgam and gold materials, where these materials were materials with a long history with clinical success and high levels of biocompatibility, but these materials have began to be abandoned due to the desire for restorative materials that mimic natural tooth structure, even for posterior teeth.[16] Conservative restorative dentistry was equipped with various techniques and systems for minimally invasive rehabilitation of posterior teeth. Resin composite materials, placed directly or indirectly, are one of the best non-metallic restorative treatment alternatives for tooth staining.

The restorative material should ideally closed to the properties of the tooth structure, have sufficient tissue adhesion strength and have a good esthetic appearance. The ideal properties of restorative materials can be divided into 4 categories, they are physical-mechanical properties, biocompatibility, aesthetics and applications.[17]

Behind must have good physical-mechanical properties, the material must be stable in acid-base conditions of the oral cavity, low thermal conductivity, and has the resistance to permanent deformation or fracture by chewing pressure, resist corrosion, and have good chemical bonds with tooth structure. The material can bind well to the biological conditions of the oral cavity, and can come in contact with the mucosa and other dental tissues not to be toxic. It is similar in color, translucency, and texture to teeth, also the material is easy to apply to the teeth.[17]

2.2 Types of Restoration

Choosing the best type of restoration for the patient by considering the advantage and disadvantage is the responsibility of a dentist. The choice of restoration type is a challenge because there are so many types of restoration materials and techniques available. In restoration treatment, there are two actions that could be performed based on clinical indications of tooth decay. Types of treatment that can be selected are direct and indirect.The choice of restoration type was influenced by certain factors such as financial feasibility, time involved, physical properties of restorative materials, difficulty of placement and longevity of the restoration.[18]

In other cases also when the tooth has lost substantial tissue, direct restorations are difficult to recreate the proper contour, contact and occlusion of the teeth. If this happens indirect restoration was considering because it was more capable to crate a restoration with better functions.[18]

2.2.1 Direct Restoration

Immediate restoration treatment is the most conservative treatment. Removing as little tissue as possible is accomplished by removing the damaged portion of the tooth structure, including the brittle material, removed as necessary to create proper retention, and then the restorative material replacing the original tooth structure, ensuring the same structure, function and aesthetics as the natural teeth.[18] Direct non-aesthetic restorative materials include amalgam, Gold direct filling. Direct aesthetic restorative materials include composite resins, glass ionomer cements, GIC modified resins, compomers.[15]

2.2.2 Indirect Restoration

Indirect dental restorations are restorations made outside the mouth. The fabrication of the filling material is performed on replicas of the prepared teeth or by using computer-aided design/computer-assisted manufacturing (CAD/CAM) for both techniques which is also performed in the laboratory. In this type of restoration, it is necessary to consider the use of impression materials, forms of tooth preparation, temporary dental fillings, fittings of restorative materials, cementation materials, and also the use of liners and bases.[19]

In the case of extensive tooth decay, the restorative material used is a restorative material that has good stress distribution characteristics and can give better impact to the remaining tooth structure. The use of a more liquid material for direct use is not possible in such a case. So it is necessary to make dental fillings outside the mouth which will later be glued to the prepared teeth. The margin of indirect partial restorations is generally at the supra-gingival level, which provides many advantages; reduces harm to the periodontal tissues, easy access to finishing margins, allows for easier and more effective daily cleaning and annual inspections, thereby, reducing the occurrence of secondary caries. In addition, the remaining tooth structure can be used as a guide to construct the physiological contours of the teeth to maintain individual features.[18]

Indirect restorations include inlays, onlays, veneers and bridge dentures. If based on the material, it can be a metal or non-metal restoration. Examples of metals are gold restorations and cast metals, while non-metals are indirect composites and porcelain. Indirect restorations are also classified into intracoronal and extracoronal, inlays are an example of intracoronal while onlays fall into the intracoronal and extracoronal classifications.[15]

2.3 Biomaterials Dentistry

The use of biomaterials in medicine and dentistry was introduced in the 1950s.[20] Biomaterials are important components in modern medicine. Biomaterials in dentistry include all materials or devices used in the oral cavity for the diagnosis and treatment of diseases of the oral cavity. Rapid technological advances also have an impact on changing the definition of biomaterials. Biomaterials are defined as substances engineered to take shape, which either alone or as part of complex systems, interact with living tissue components to direct the course of any therapeutic or diagnostic procedure.[21]

Understanding the properties of biomaterials is important to compare with the properties of hard and soft tissues in the oral cavity before taking treatment.

Clinical distortions and failures tend to be obstacles in carrying out treatment, especially dental restorations. Dental restorations sometimes do not fit into the supporting tissues of the mouth due to failure of the interface or substrate. Until now there are no biomaterials that have ideal properties, so the success of treatment actions depends on understanding the physical, mechanical and biological properties of biomaterials.[22]

2.3.1 Tensile Strength

Tensile Strength is the maximum amount of stress that a material can withstand before breaking due to load or tension.[23] Tensile tests can be performed with certain materials such as wire but cannot be used with materials such as dental cement.[24]

2.3.2 Compressive Strength

Compressive strength is the maximum amount of stress that a material can withstand before breaking due to load or compressive force.[23] Compressive strength test using a cylinder sample. In measuring compressive strength, a cylindrical specimen made of brittle material is compressed vertically until it breaks.[24]

2.3.3 Diametral Tensile Strength

This diametral tensile strength is known as an indirect tensile test.[23] Test the diametral tensile strength using a disc and applying force to the edge.[24] During the test, the compressive force applied to the specimen induces a tensile stress which is perpendicular to the direction of the applied force (the tensile stress is directly proportional to the applied force).[23]

2.3.4 Flexural Strength

Flexural strength or transverse strength or modulus of failure was measured using the three-point or four-point bend test method.[23] Many new ceramics such as lithium disilicate and monolithic zirconia have greatly increased indentation strength compared to feldspatic porcelain or leucite reinforced ceramics.[24]

2.3.5 Fracture Toughness

Fracture toughness is one of the most valuable in vitro tests because it evaluates failure starting from a predetermined defect. It is possible that materials with better fracture toughness may show better clinical performance.[24] Fracture toughness is to provide the amount of energy required to resist crack propagation in a brittle material under an applied force.[23]

2.3.6 Elastic Modulus

The modulus of elasticity is a measure of the relative stiffness or rigidity of a material. The modulus of elasticity is the ratio of stress to strain and is the slope of the straight-line portion of the stress-strain diagram. It is a measure of how the material will deform when placed under pressure.[24] It is a measure of the intrinsic properties of a material: the stronger the interatomic forces (basic interaction forces), the greater the elastic modulus value, and therefore, the material will be more rigid and rigid (resistant to elastic deformation).[23]

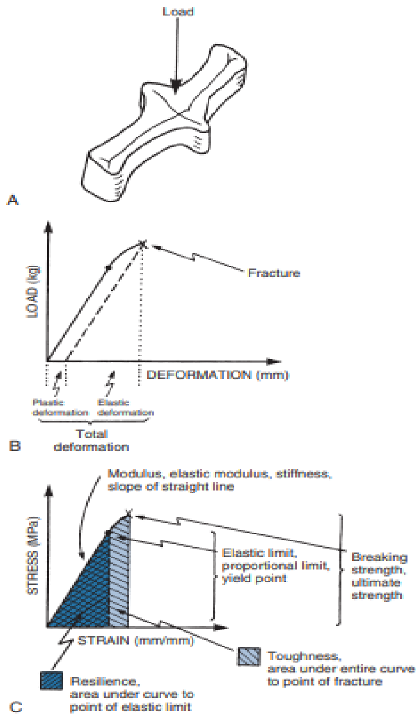

Figure 1. Elastic modulus diagram.

Source: Reference number 24

The advantage of the elastic modulus property of materials is in the recovery of noncarious cervical lesions (NCCLs). One of the potential etiologies of NCCL is dental indentation causing cervical damage. Traditionally, materials with a low elastic modulus such as microiled composite resins and modified glass ionomer resins are more successful in recovering NCCLs than rigid materials such as hybrid composite resins.

2.3.7 Biocompatibility

Biocompatibility is the ability of a material to perform its intended function without causing local or systemic adverse reactions to the use of the material. In the sense that biocompatible is the property of a material that is able to bond well with tissues in the body. Biocompatibility is a dynamic process due to changes in material properties and host response over a period of time, for example due to corrosion, disease and long aging. Simple ways to test the biocompatibility of materials are in vitro testing, in vivo testing in animal models, and usability testing.[23]

2.3.8 Toxicity and Cytotoxicity

The biological properties of biomaterials are related to the toxicity and sensitivity reactions that occur locally, in related tissues, and systemically.[24] Toxicity is the ability of a material to damage biological systems by releasing chemicals.[23] Two clinically important factors that determine toxicity are the time of exposure and the concentration of the potentially toxic substance. Generally, restorative materials harden rapidly or are insoluble in tissue fluids (or both). Potentially toxic products do not have time to diffuse into the tissues.[24] In vitro studies have shown that when the setting reaction in restorative materials (such as resin-modified glass ionomer cements and resin composites) is incomplete, the cytotoxic effect is caused by the release of materials from incompletely formed materials that alter cellular metabolic processes. Toxicity is classified as local or systemic toxicity: (1)Local toxicity: Damage occurs in the form of inflammation or necrosis at the application site of the biomaterial. (2) Systemic toxicity: The damage is superficial or occurs in areas far from the place of application of the material.[24]

In general, biomaterials are categorized as bioinert, bioactive or biodegradable. Bioinert materials do not interact with the tissues/environment in which they are placed e.g. bone screws and plates. In contrast, bioactive ingredients interact directly with the surrounding environment. Such interactions include interactions in which the material binds chemically to hard or soft tissue, interactions that induce the release of biological substances, or interactions that enhance the healing abilities of the tissue. The purpose of biodegradable materials is to offer a difference in benefits for a limited period of time. A typical example is a suture material that degrades at a rate similar to tissue regeneration.[20]

Biomaterials are also classified according to their ability to absorb. That is, absorbable or non-absorbable materials. These special properties are important to determine the indications and contraindications of biomaterials. Thus it is easy to assess its suitability in various clinical situations. Biomaterials can also be classified according to their origin. namely, synthetic materials and natural materials. Different chemical composition positions are used to produce polymer biomaterials and bone substitute materials (BSM). In the case of absorbable BSM, hydroxyapatite, tricalcium phosphate and their combinations are widely used. Absorbable synthetic polymers, such as polycaprolactone (PCL), polylactic acid (PLA), and poly(co-glycolic acid lactic) (PLGA) have shown successful and promising results as BSMs and polymeric membranes in various surgical fields. Among the group of non-absorbable synthetic materials, especially in the field of periodontology, polytetrafluorethylene (PTFE) membranes have demonstrated good biocompatibility and provide physical barriers when applied in terms of bone and tissue regeneration.[22]

Natural biomaterials are the most preferred materials for clinical applications, due to their natural structure and similarity to the structure of human tissue, so these materials are considered the most suitable for clinical use. Most naturally derived substances are classified according to their origin as allogeneic (human), xenogeneic (animal), or phycogene (plant). Within the BSM group, natural bone is obtained from the same or different species and purified/processed to make it suitable for human clinical applications.[22]

In the polymer biomaterial group, collagen is the most preferred and widely used natural material. Collagen is a highly conserved protein across species. Its ubiquitous presence in the extracellular matrix supports regeneration by offering a suitable surface for cells involved in the regeneration process. Another naturally occurring polymeric biomaterial is silk fibroin, which is extracted from silkworms or spiders. This absorbable biomaterial exhibits a high degree of biocompatibility in vitro and in vivo and is therefore used as a suture material and a bone substitute material as well.[22]

According to the system, biomaterials are classified into six different systems, namely, metal systems, ceramic systems, polymer systems, carbon material systems, composite systems, and biological engineering systems.[21]

2.4 Resin Composite

There are three main ingredients in composite resin, the first is the resin matrix; fillers available in various compositions, sizes, and shapes; and the third is silane coupling agents. The most commonly used resin matrix is Bis-GMA. Several composite resins use urethane dimethacrylate (UDM) as the matrix and the two resins are substantially equivalent in terms of clinical performance. Bis-GMA was synthesized from an epoxy type by Bowen. It is determined by a polymerization reaction and its main advantage over methyl methacrylate is that the monomer molecule is substantially larger than that of methyl methacrylate monomer. results clinically in significantly less polymerization shrinkage. The filler particles in composite resins are composed of quartz or silica, and vary widely in size and shape. Incorporation of disintegrants into the resin matrix increases the strength of the material and further reduces the amount of polymerization shrinkage.[24]

There are two systems used regarding filler particles in composite resins. First is the more filler, the better. This is because the composite will shrink 2.4% - 2.8%. Even contemporary composite resin materials for restorations must contain at least 75% fillers by weight. The second is that the smaller the average filler particle size, the better. Materials with small filler particles are easy to polish and can even maintain their polish for a long time, and don't wear out easily. [24]

The filler is bound to the resin matrix by coupling agents. Silane has a complex system, where the molecule is bifunctional. One of them can bind to the filler and the other binds to the matrix resin. The use of silane allows for a stronger bond between filler and matrix, increases wear resistance, and increases the amount of filler incorporation into the matrix. The silanization process works by involving coating particles which then lock in acetone to thin the silane thickness into a monomolecular layer. Composite resin materials also contain many other components including pigments, viscosity diluents, crosslinking agents, and initiators.[25]

2.5 Classification Resin Composite

Composites consist of synthetic materials (such as dental composite fillings) and natural materials (such as bone) or may be particulate or fibrous, or both, in nature. The main advantage of composites is similar to polymers, namely, the ability to manipulate the manufacturing process to produce the desired material properties. These materials can be used in hard and soft tissue applications including: dental restorations, fracture repairs, joint replacements, wound dressings, implants and grafts.[21]

2.6 Natural Biocomposite

Composite biomaterials are materials that contain two or more different constituents or phases.[20] Biocomposite structures are made up of biomaterial compounds with filler elements dispersed into a matrix material or construction with alternative parts of different materials.[21]

Biocomposites are considered as materials consisting of at least one natural resource. Biocomposites that are reinforced with natural fibers are referred to as natural biocomposites. The added value of natural fibers provides natural biocomposites with various physical, mechanical and biological properties. Due to the advantageous properties, abundance and low cost of natural fibers, it is considered as a new generation of reinforcement for polymer matrices. The manufacture of natural biocomposites is carried out by a variety of techniques, compression molding, injection molding, resin transfer molding, sheet molding, hand lay-up, filament winding, extrusion and pultrusion. This process allows natural fibers to be presented in the form of woven fibers, making it possible to position the fibers in the desired direction to obtain certain mechanical properties in the final product. However, things to consider are also the type of natural fiber used, the chemical compatibility of the matrix and fiber phases.[21]

Development of natural biocompatibility biocomposites has been carried out by adding specific biomolecules with specific properties, such as antimicrobial, anti-inflammatory, analgesic, sedative, anti-oxidative, UV protection or chemical stability.[25]

2.7 Biocomposite Natural Waste Sugarcane (*Bagasse*) Fiber

Bagasse fiber is a fiber with a large production with a figure of 75,000 103 tonnes of world production.[26] This composition makes it an ideal material to be applied and utilized as a reinforcing fiber in composite materials for the purposes of making new materials which have different physical and chemical properties. Bagasse has 55.2% cellulose, 16.8% hemicellulose, 25.3% lignin, 1.7% ash and wax.[27]

Cellulose (C6H10O5)n is an organic polysaccharide biopolymer consisting of linear chains of several hundred to thousands of β(1→4) linked D-glucose units. Cellulose has structural properties due to the fact that it can maintain a semi-crystalline state of aggregation even in an aqueous environment, which is unusual for polysaccharides.[28] Cellulose is composed of D-glucopyranose units linked by -(1-4)-glucosidic bonds. Cellulose is the strongest and most rigid fiber component, providing the fiber surface with several hydroxyl groups (-OH) and making it hydrophilic..[29] Due to the large proportion of hydroxyl groups in the structure of cellulose, there is a high affinity for moisture, which generally affects the dimensional stability of the fiber matrix composite. However, cellulose has a positive correlation with the strength, elastic properties and physical characteristics of the fiber.[30]

The hemicellulose polymer is the most hydrophilic and partially water soluble constituent of wood. Hemicellulose is completely amorphous and is bound tightly to cellulose fibrils probably by hydrogen bonds. Lignin is a highly complex and aromatic polymer of phenylpropane units. It is amorphous and binds crystalline cellulose with hemicellulose in the cell wall. hemicellulose increases the strength of wood in dry conditions, lignin maintains the strength of wood in wet conditions.[30]

Cellulose is a wood constituent compound in the form of microfibrils which account for about 40-50% of the wood. This compound has strong and rigid properties so that it is thought to be the main factor in adding strength to natural fibers. Another compound, namely hemicellulose which is in between the cellulose groups. Hemicellulose is a binder between cellulose compounds, so that the bonds between cellulose become stronger. While the lignin compound is a wrapper of the other two compounds. Cellulose and hemicellulose will bond to form cross-links, then surrounded and wrapped by lignin.[27]

Cellulose has a positive correlation with tensile strength and Young's modulus, whereas lignin has an effect since and vice versa. In addition to cellulose, hemicellulose and wax content are positively correlated with Young's modulus. Furthermore, the content of lignin and pectin decreased the specific Young's modulus, while the increase in moisture was affected by hemicellulose and lignin. The relationship between the chemical composition, and the mechanical and physical properties of the fiber is shown in:[27]

Tabel 1. Correlation of chemical content to mechanical properties.

Chemical component of natural fibers	**Parameters of mechanical properties**				**Parameters of physical properties**		
	Tensile strength	Specific Young's Modulus	Failure strain	Microfibril Angle (MFA)	Diameter	Density	Moisture Gain
Cellulose	xxx	xx	-	-	x	xxx	-
Hemicellulose	-	xxx	xx	-	x	-	xx
Lignin	-	-	xxx	xxx	-	-	xx
Pectin	-	-	xx	xxx	-	xxx	-
Wax	-	xx	-	-	-	-	x
Catatan: Simbol:(x): korelasi positif, (-): korelasi negatif.							

Source: Reference number 27