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Microbial Production of Biopaper Pulp

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A B S T R A C T

Cellulose are the most abundant source of organic carbon source that accounts for about 50% of the earth's carbon. Bacterial Cellulose or Bio-Cellulose (BC) is a bio-polysaccharide naturally produced by some acetic acid bacteria. The bacterial cellulose producing strain from rotten fruits, fermented vinegar, soil, souring juices have reported for higher their production. Bacterial cellulose has received great attention and has been applied in a variety of commercial applications due to its high tensile strength, better quality, high purity, and water holding capacity. Bacterial cellulose has been used as a raw material for producing high-fidelity acoustic speakers, high-quality paper and dietary foods and many other acivities without wasting the woods so that can also prevent the environmental demages, So the current review is to focus on the bacterial cellulose production and its application.

KEY WORDS: Bio Paper, Bacterial Cellulose, Bio Paperpulp, Cellulose

1.INTRODUCTION

Bacterial cellulose is bio-polysaccharide. That produce by acetic acid bacteria. This type of microorganisms are gram negative bacteria. This acetic acid bacteria oxidize sugar or ethanol and prduce acetic acid during fermentation process. We are providing rotten fruits or vinegar as sugar or ethanol source to bacteria (Ramana, K.V.; Singh, L.; Singh, Lokendra (2000)). That bacteria produce cellulose in to a pellicle form that pellicle is visibly flat. Now that pellicle shoud required alkali treatment for make pellicle to sheet (White, D.G. & Brown, R.M. 1989). Which membrane have various chemical method is used in various industrtial process.improvement bacterial cellulose is bio-polysaccharide. That produce by acetic acid bacteria. This type of microorganisms are gram negative bacteria. This acetic acid bacteria oxidize sugar or ethanol and prduce acetic acid during fermentation process. We are providing rotten fruits or vinegar as sugar or ethanol source to bacteria [1]. That bacteria produce cellulose in to a pellicle form that pellicle is visibly flat. Now that pellicle shoud required alkali treatment for make pellicle to sheet [2]. Which membrane have various chemical method is used in various industrtial process.improvement in cellulose production is beneficial for large application of cellulose. Sugar, alcohol and nitrogen this three sources effect to cellulose production. So this three sources attempt to maximize bacterial cellulose production (Masaoka, S., Ohe, T. & Sakota, N. 1993). We can observe effect of carbon and nitrogen sources in bacterial cellulose production by some techniques. The analysis of pp complexed with cellulose fibrils is done by sds-page. And alkali treated cellulose pellicle or sheet studied by scanning electron microscopy.Due to several special qualities like thermal stability, nanostructure, purity, and compatibility, bacterial cellulose (bc) as a biopolymer has drawn considerable interest in the biotechnological community. Because of its simple manufacture and excellent performance, it is a widely used polymer. Due to its nano-scale architecture, it has significant uses in the biomedical and food industries as well as being a possible scaffold for tissue engineering and textiles (P. Gateholm, Bacterial cellulose as a potential scaffold for tissue engineering of cartilage, Biomaterials 26 (2005), a review of recent advances, Carbohydr. Polym., The healing property of a bioactive wound dressing prepared by the combination of bacterial cellulose (BC) and Zingiber officinale root aqueous extract in rats, 3 Biotech 9 (2019), J. Kim, Z. Cai, H.S. Lee, G.S. Choi, D.H. Lee, C. Jo, Preparation and characterization of a bacterial cellulose/chitosan composite for potential biomedical application, J. Polym. Res. 18 (2011)) For the food and healthcare industries, bc is classified as "generally regarded as safe (gras)"(A. Rastogi, J. Singh, M. Das, D. Kundu, R. Banerjee, An Understanding of Bacterial Cellulose and Its Potential Impact on Industrial Applications). Within the bacterial system, cellulose is made from glucose chains and manifests as fibrils within the bacterial cell wall.A strain of acetobacter xylinum, now known as the genus gluconacetobacter and often found on rotting fruits, vegetables, vinegar, fruit juices, and alcoholic beverages, can be cultured to create microbial cellulose. This family of microorganisms transform ethanol into acetic acid. In the earlier research, various attempts \swere undertaken to extract gluconacetobacter sp. From fruits (Description of Gluconacetobacter swingsii sp. nov. and Gluconacetobacter rhaeticus sp. nov., isolated from Italian apple fruit," International Journal of Systematic and Evolutionary Microbiology), \sflowers, fermented foods (Production of bacterial cellulose by Gluconacetobacter hansenif PJK isolated from rotten apple," Biotechnology and Bioprocess Engineering, vol. 8), beverages (Cellulose production from Gluconobacter oxydans TQ-B2," Biotechnology and Bioprocess Engineering, vol. 9), and vinegar. We sought to extract cellulose-producing bacteria from decaying fruits and vegetables for the current investigation.

2.Cellulose producing organisms

Aceticacid producing bacteria produce bacterial cellulose. *Acetobacter spp*. Is most commonly uased for cellulose production.(M. Shoda, Y. Sugano (2005)) that organisms cause polymerization of glucose into a long and unbranched chain formation. It was make cellulose pellicle (Brown, Jr (1987). "The biosynthesis of cellulose". Food Hydrocolloids., Delmer, D.P.; Amor, Y. (1995)). That organisms may be aerobic and it is gram negative. That bacteria need carbon, nitrogenand other neutritional molecules for growth. We providing glucose as carbon source for bacterial cellulose production. We can also produce bacterial cellulose on sugarcane or sugarcane containing media, here sugar molecule act as carbon source (Iannino, N.I. De; Couso, R.O.; Dankert, M.A. (1998)).numerous bacterial cellulose makers were identified, and their capacity to generate cellulose was assessed. The screening condition improvement tests were conducted using *acetobacter pasteurianus* ferm p-12884. In the cultivation tests, controls included *acetobacter xylinum* a tcc 10821, a tcc 23769, and a. *Pasteurianus* a tcc 10245.In the characterization tests of the best isolate from a taxonomical perspective, *acetobacter xylinum* ifo 15237 (type strain), *acetobacter hansenii* atcc 35959 (type strain), *acetobacter liquefaciens* atcc 14835 (type strain), a. *Pasteurianus* a tcc 33445 (type strain), *acetobacter aceti* atcc 15973 (type strain), and *gluconobacter oxidans* atcc.

3.Fermentation production of bacterial cellulose

When carbon source is high and nitrogen is minimal then bacterial growth getting high (Ramana, K.V.; Singh, L.; Singh, Lokendra (2000)). Most commonly glucose and sucrose are used for bacterial cellulose. Fructose, maltose, starch, glycerol and xylose also tried as carbon source in bacterial cellulose production (Masaoka, S.; Ohe, T.; Sakota, N. (1993).) ethanol also used for increasing productivity of bacterial cellulose (Park, J.K.; Jung, J.Y.; Park, Y.H. (2003)). by using glucose as carbon source bacteria formed glucomic acid as their byproduct. Here that glucomic acid is decrease ph level of culture. That is a problem which is we have to face when we use glucose as carbon source. But solution is that in presence of lignosulfonate we can decrease glucomic acid production(Keshk, S.; Sameshima, K. (2006)). Acetic acid helps in higher production of cellulose (Toda, K.; Asakura, T.; Fukaya, M.; Entani, E.; Kawamura, Y. (1997)) If we are adding sugar cane molasses some strain increase bacterial cellulose production (Premjet, S.; Premjet, D.; Ohtani, Y. (2007)). For cellulose production pyridoxine, nicotinic acid, p. Aminobemoic acid and biotin are important vitamins. Here pantothenate and reboflevin does opposite effect in cellulose production (Matsunaga, M.; Tsuchida, T.; Matsushita, K.; Adachi, O.; Yoshinaga, F. (1996)).Each sample was obtained separately, weighed out at 1 g, and serially diluted up to 106 times in 9 ml of 0.9 percent saline using the pour plate method. Hestrin-schramm agar standard (yeast, 20 g/l of glucose, 5 g/l of yeast extract, 5 g/l of peptone, and 2.7 g/l of disodium phosphate, 1.15 g/l of citric acid and 15 g/l of agar) incubated for 48 hours at 30°c. Nine ml were infected with one loopful of each isolate of hestrin-schramm medium. These tubes were statically incubated at 30°c for a week. The tubes with white pellicle after incubation were chosen to cover the liquid medium's surface. At the air-liquid contact, pellicle formation was monitored in every flask. By repeatedly streaking the culture on hs agar plates, the flasks exhibiting pellicle growth were chosen and purified to produce isolated colonies. The screening media, hs agar with fluorescent brightener dye (0.02 percent w/v) and the antifungal drug cycloheximide, were inoculated with each unique isolate and incubated at 30°c for 3 days. The organism's cellulose content forms a bond with the luminous dye. When viewed under uv light, bacterial colonies that produce cellulose glow. The luminous colonies were chosen to make cellulose as a result (B. S. Hungund and S. G. Gupta,).

4.Proprties and characterization

When biopaper made from bacterial cellulose that sheets have good mechanical properties. Bacterial cellulose's pellicle was tough rather than wood cellulose (Iguchi, M.; Yamanaka, S.; Budhiono, A. (2000)). The sheet of bacterial cellulose's modules are bound tightly by hydrogen bonds. The fibers which is present in bacterial cellulose is more thinner than those cellulose fibr which is produced by wood pulp (A. Steinbuhel, "Bacterial Cellulose." Biopolymers. Weinheim: Wiley-VCH, 2001). Bacterial cellulose is also differentiate from plant. Differentiation is based on crystallinity index. Crystalline form of cellulose is designated as 1 and 2. That two type can differentiate by x-ray, nuclear magnetic resonance (nmr), raman spectroscopy and infrared analysis (A. Svensson, E. Nicklasson al, (2005)). If in bacterial cellulose's structure all cystels are arranged parallel then it is called cellulose 1. And if in bacterial cellulose's structure all crystels are arranged antiparallel than it is called cellulose 2. The cellulose 2 is thermodynamically stable form (engineering of cartilage, Biomaterials 26 (2005)). That study of molecular arrangement in sheet is done by x-ray diffract (Nishi, Y.; et al. (1990)).

5.Applications

Bacterial cellulose is more applicable because of those unique properties.

5.1 Food

Bacterial cellulose is oldest used in philippines. Bacterial cellulose used as a raw material for make "nata de pina" it is a traditional sweet candy dessert of Philippines (Fontana, J.D. et al (2017)). Due to bacterial cellulose's texure and fiber content it is also used as thickener. Bacterial cellulose's use as thickener is for maintain the viscosity of food. Bacterial cellulose has been added as dietary fiber to many foods. Cellulon is a bulking agent. It was used as food ingredient. That cellulon used as food ingredient is act as thickener , texurizer and calorie reducer.Bacterial cellulose has used in japan's beverages in 1992. In japan'ss beverages bacterial cellulose used in kombucha, that kombucha is a fermented tea drink (Bajaj, I; Chawla, P; Singhal, R; Survase, S. "Microbial cellulose).

5.2 Commercial products

In commercial sector bacterial cellulose used for ultra strengthy paper making industry. Bacterial cellulose used as ultra strength paper. Binding, thickening and reticulated fine fiber network with coating (Vandamme, E.J.; Baets, S. De; Vanbaelen, A.; Joris, K.; Wulf, P. De (1998)). Bacterial cellulose has high sonic velocity and low dynamic loss. That's why sony corporation used bacterial cellulose as acoustic or filter membrane in loudspeaker and headphones (Iguchi, M.; Yamanaka, S.; Budhiono, A. (2000).). Bacterial cellulose is also tested in textile industry for making cellulose based clothes or also used in cosmetic industry (Yang, J.; Wan, X. (2010)).

5.3 Medical

In medical field bacterial cellulose has been tested and successfully used. Bacterial cellulose successfully used as wound dressing and mostly use in burn cases. When burns treated by covering with bacterial cellulose is healed faster than traditional treatment and it was remove more scarring. This is effective because of cellulose's water holding ability and water vapor permeability. High holding ability of water is provide moisture environment at injury area. The bacterial cellulose is effective to skin surface because bacterial cellulose mold well to skin surface. This technique has been successful so boifill is developed as bacterial cellulose product (Jonas, R.; Farah, Luiz F. (1998).). The x cell which is produced by xylos corporation is used primarily to treat wound from venous ulcers (Czaja, Wojciech; et al. (2007).). Traditional gauze is treated with bacterial cellulose polymer which is increase properties of gauze. When bacterial cellulose covered gauze were bacterial cellulose able to absorb liquid medicine (Meftahi, A.; et al. (2009).). In bone graft and tissue engineering also bacterial cellulose is used.

6.Conclusion

A novel biodegradable biopolymer, biocellulose/biohemicellulose, is projected to emerge. Microorganisms can be used to make biopaper. Biocellulose and biohemicellulose can substitute wood cellulose, reducing the amount of wood used in the manufacturing process. In the future, paper and fibers will be used.biocellulose/biohemicellulose development in fiber production is becoming increasingly significant in addressing environmental issues.

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