Controlled Dip Reactor Design to Increase Bakterioselulosa Produce Based on ATMega8535 Microcontroller

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ABSTRACT

Contact with O_2 and at the same time ability to absorbent of nutrient will be very determining of productivity level of bakterioselulosa. On that account, for the scale up production, there are some done efforts, like Rotary Disc Reactor (RDR), as developed by Norhayati [1]. The RDR is unable to rotate less than 7 rpm (equivalent 10 second to every rotation). At this research, weakness of the rotary disk bioreaktor was overcome by developing Controlled Dip Reactor (CDR). Excess of proposed appliance is user can arrange the the duration submerged phase in growth liquid medium and exposed to the air phase as according to experiment design, so that more effective and be free to to gain time optimum to each the phase utilize to get maximal production of bakterioselulosa. At the testing, designed appliance can lift place grow medium of bakterioselulosa toward as high as 15 cm meaning exposed to the air,and degrade place grow of bakterioselulosa medium downwards until 1 cm measured from medium place base, which mean bakterioselulosa submerged liquid of the growth medium and the time exposed to the air and exposed to the liquid can be controlled to vary from 1 until 20 minute.

KEY WORDS: *Bakterioselulosa; Bioreactor; Rotary disc reactor; ATMega microcontroller; CDR*

1.0 INTRODUCTION

Bakterioselulosa or Microbial-Cellulose, is cellulose product yielded by bacterium which grow at sugary liquid susbtrat. This Bakterioselulosa have structure, function, nature of unique mechanic and fisikokimia. Perity and purity of crystal compiler of cellulose biopolimer, making of it as very potential biomaterial to be developed to to become new products very promising at modern industry, start from audio-membran [2], LCD touch screen and electronics component [3], cell of energy [4], until its potency for the substitution of burnt husk and other medical materials [5].

Bakterioselulosa have the nature of unique as follows :

- Has very high purity, because does not contain lignine or hemiselulosa as well as plants
- Has very high crystallinity, so that potential to be exploited upon which making of LCD (crystal liquid display) for the equipments of electronic like TV screen, computer, laptop, smartphone, etcetera.
- Sheet of Bakterioselulosa very strong, owning Young modulus equal to 1530 GPA, the strongest among all organic material 2 dimension existing.
- Owning very good biodegradability
- Has the big ability fasten water (capacity holding water) , about 100 times fold from dry weight.
- Owning good biology afinity, so that potential to be used in the place of husk for the cover of hurt.

Thereby potency of bakterioselulosa not merely to be exploited upon which just food, but potential also to be developed upon which high economic valuable and certifiable other industrial product, so that make this biomaterial as research obyek which these days draw to be studied. Products able to be yielded from bakterioselulosa can be seen at Table1.

Table 1: Product able to be yielded from akterioselulosa

Industrial type	Product result
Food	Food (nata de coco, low calorie ice-cream , light food, salad of dressing, which can lessen kolestrol)
Electronics	LCD (liquid crystal display) for tv, computer screen, smartphone screen
Health Service	For the tanner of hurt (hurt drug), substrat making of artificial husk.
Cosmetic and beauty	Skin Nutrition, to beautify nail, as sponge of biomaterial.
Mining and Oil	Improve quality of oil mineral
Clothes And Shoe	Shoe product and artificial leather suitcase, for the textile
Public facility	Filter Purification of Water, osmosis membrane and buffer return.
Product requirement of baby	Disposable recyclable diapers.
Audio Product	Diaphragm Audio.
Product result of forest	Glue of artificial Wood (Plywood), paper filter
Paper product	As paper to make durable money.
Paper product	yielded by cellulose fibre have potency to make strong and light car bodi, also as plane body element, casing (rocket body)

Source: (Brown, 1976)

Production process of bakterioselulosa commonly using static breeder method, that is grow microbe which forming cellulose coat at surface of liquid medium which used. To grow and produce bakterioselulosa, A. xylinum need O2 for the metabolism of sugar nutrient as media of is growing of. Contact with O2 and at the same time ability A. absorbent xylinum of nutrient will very is determining of productivity level of Bakterioselulosa [6] On that account some done effort, among others by using appliance which is inovatif, like Rotary Disc Reactor (RDR) developed by Norhayati [7]. With RDR, A. xylinum which patch at disk can get disk moment nutrient of submerged, and hereinafter get the opportunity contact with rotary O2 disk moment and terekspose on the air. Innovation of RDR developed to produce this bakterioselulosa succeed to get patent in Malaysia. Result of research of Norhayati the show production of bakterioselulosa which progressively mount along with increasing the the duration disk of submerged in medium and the duration to the exposed on the air. Equally, progressively lower speed of rotation of RDR, excelsior produce Bakterioselulosa. But weakness of RDR which is told in the research is motor of disk of bioreactor cannot more slow from 7 rpm, so that less effective if used to look for submerged phase and optimal phase to the exposed in perceiving production and maximal growth of bakterioselulosa.

On that account this research is developed alternative method to solving the problem of above designed a new inovatif bioreaktor which named Controlled Dip Reactor (CDR), or referred also as Bioreaktor Dye, considering its activity principle is to grow microbe producer of cellulose at plunged disk into growth medium, then re-lifted so that earning exposed the air and contact with oxygen. Excess of this appliance is the the duration medium dilution submerged phase and exposed the air phase can be arranged by timer able to be controlled as according to experiment with desain desired, even can be arranged much more slow than made by RDR Norhayati above. With this device, a researcher can research into with controlling timer of appliance mentioned as effort gain time optimum to each the phase utilize to get maximal production of bakterioselulosa.

This research is hereinafter focussed usage of appliance of Bioreaktor Dye by doing experiment in the form of treatment of time variation of the duration disk died in and medium of exposed to the air, so that can be obtained by time dye and optimal ekspose and maximal cellulose yield. This matter is enabled to be done, because bioreaktor dye this can arrange the the duration time of submerged in media and phase contact with air (and give better aerasi to bakteri), from result of this research, later we earn to know optimal time to both the phase in course of production proces of bakterioselulosa.

2.0 LITERATURE REVIEW

2.1 Cellulose of bacterium (bakterioselulosa)

Cellulose yielded by bacterium of Acetobacter conceived of inveterate bakterioselulosa (cellulose yielded by bacterium) or cellulose mikrobial. Chemical molecule formula of bakterioselulosa is$(C_6H_{10}0_5)_n$ owning tying β - 1,4 between two molecule of monosakarida compiling the polymer (figure 1), looking like with plant cellulose molecule, but measuring up to different fisiko-kimia [9].

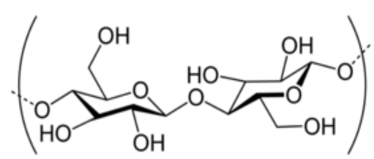

Figure 1: Cellulose represent polymer β-D-glukosa

2.2 Metabolism forming of bakterioselulosa

Bakterioselulosa yielded by A.Xylinum constructively cellulose enzyme of sintetase, will be dissociated by components export cellulose go out cell in the form of yarns of protofibril before finally smooth sheet bundle notching of cellulose (figure 3) in the form of structured ribbon of bundle of mikrofibril [9]. this smooth and very thin Cellulose ribbon, thickly 1 / 100 from crop cellulose size measure. this Cellulose ribbon then grow and expand in line with metabolism process of A.Xylinum form very regular smooth ribbons structure and have very high perity, is not harsh like plant cellulose.

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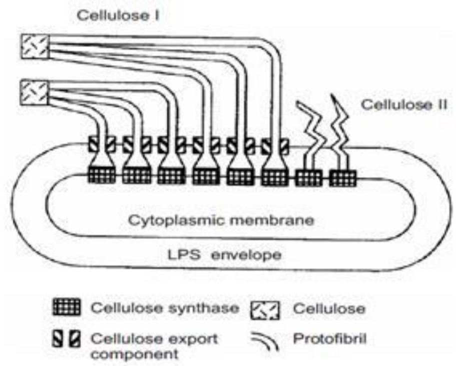

Figure 2: Process forming of microbial-selulosa by Acetobacter xylinum.

2.3 Environment Condition for the Production of Bakterioselulosa

Growth of Acetobacter xylinum influenced by various factor, good of bichemistry and physical. Physical factor cover pH, temperature, oxygen concentration, dampness, hydrostatic pressure, osmotic pressure and of radiasi. While important biochemical factor for the biosintesis of bakterioselulosa is nutrient composition, like availibility of carbon, nitrogen, brimstone, phosphorus, lilliputian element and vitamin.

From gender of Acetobacter, what most ekstensif studied by from species of Acetobacter xylinum. Bacterium producer of cellulose can grow in many uliginous media of coconut, domestic waste product or in sugary synthetic nutrient medium as source of amonium salt and carbon as source of nitrogen. At static medium , bakterioselulosa grow on the surface of medium condensation form white chromatic film coat or krem, insoluble in water, looking like thick jelly consisting of cell and polisakarida of Acetobacter xylinum which grow at surface of sugary media and other nutrisi [10]. Source of nitrogen addressed to stimulate activity of Acetobacter xylinum. Source of nitrogen coming from inorganic and also organic materials generally can improve activity of Acetobacter xylinum in sugar mensintesis become cellulose which finally form bakterioselulosa. Source of nitrogen used occasionally in course of ferment is (NH4)2SO4, (NH4)H2PO4, (NH4)NO3, urea, ZA, and NPK [11].

Acetobacterxylinum is bacterium of aerobik obligat owning metabolism base on oxygen. Therefore, needed by oxygen for the respirasi of their aerobik to oxidize substrat like glucose to get energi and convert glucose become cellulose. Bacterium cell can get oxygen on the air through dilution interface where cellulose yielded. Oxygen considered to be constrictor factor for the growth of and forming of cellulose. Oxygen concentration have limitation, too much dissolve oxygen in medium will improve acid contents of glukonat but oxygen concentration too low cannot provide oxygen which last for growth so that lessen cellulose production [12].

2.4 Controlled Timing Program

Especial heart which control time of submerged phase and exposed to the air phase at prototype design bioreaktor dye is program function control entered time into ATMega8535 microcontroller.

Function Time of submerged phase expressed with :

Wait Timer_Bottom

and time function for the exposed to the air phase expressed with:

Wait Timer_Top

Both of this function will control the the duration time required for the submerged phase and exposed to the air phase according to wanted. Completely controlled timing program written down as follows:

```
For I = 1 to looping
  Timer_Bawah = 1 ( example of assess time value)
  Timer_Atas = 10 ( example of assess time value)
If Pinb.0 = 0 Then ( if switch bottom is connected )
  Portc = 2
  Wait 1
  Portc = 0 ( until top switch connected)
End if
Next
End
```

2.5. Minimum System of ATMega8535 Microcontroller

Malvino [13] please explain that Microcontroller not like computer system, capable to handle assortedly application program (for example word processing, processor of number and others), microcontroller only can be used to one just certain application. Other difference lay in comparison of RAM and ROM. At computer system comparison of RAM and its ROM is big, its meaning consumer program kept in RAM room which is big relative, while hardware interface routine kept in room of ROM small. While microcontroller, comparison of ROM and its RAM is big meaning control program kept in ROM (can Masked ROM or of Flash PEROM) which is its bigger size measure relative, while RAM used as repository whereas, including used register at pertinent microcontroller.

The prototype device of this appliance is functioning microcontroller as system brain which controlling time and which giving comand for the lift on and lift off of media place of bakterioselulosa.

3.0 METHODOLOGY

3.1 Controlled Dip Reactor Prototype Testing

- **Dc motor control circuit testing**

  From dc motor control circuit design its result can be seen at figure 3.

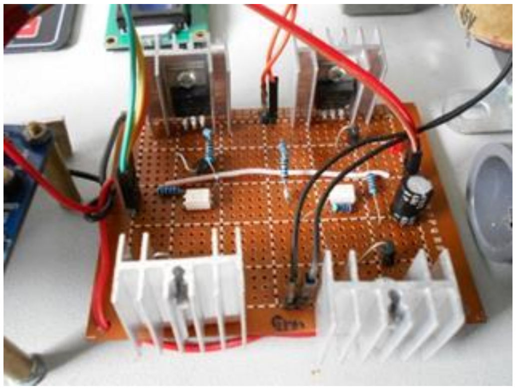

Figure 3: Result of dc motor control circuit design

Testing done to know do dc motor can rotate to left, righ and

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off as according to input data, the result is as tables of following :

Table 2: Result of testing dc motor control table

Input Data	Dc Motor condition
1 1	Off
1 0	Rotating righ
0 0	Off
0 1	Rotating Left

From tested,dc motor control circuit can control motor to rotate righ and rotate left , and off as according to entered data.

- **Testing reach under – to the top**

  This testing is done to see do mechanical system can to draw to the top and degrade downwards so that place grow of bakterioselulosa exposed to the air and exposed to the liquid.Moving downwards this got from motor rotation motion of dc motor which is translated by thread lever system become motion of its construction.The result can be seen at figure 4 following.

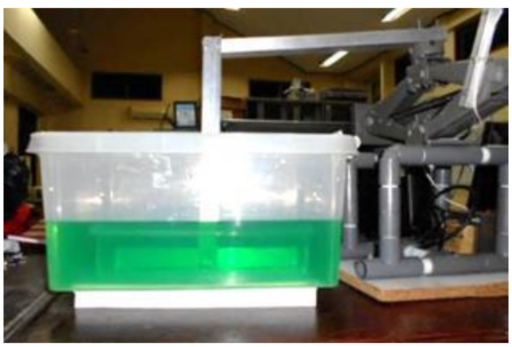

Figure 4: The result of mechanical construction move to the under and to the top

From done by test the result shall be as follows.

Table 5: The result testing mechanical moving

Motor rotating	Reach under – to the top
100 rpm	5 cm
150 rpm	8 cm
200 rpm	12 cm
250 rpm	15 cm

From done test system of mechanical earn translated move dc motor rotation become motion of maximum 15 cm from under place of place bakterioselulosa grow.

- **Testing timing program of exposed to the air and exposed to the liquid**

  This test is done to know do made program can to give time of submerged liquid and exposed to the air which vary as according to given time input.

  Program which have been made shall be as follows :

Figure 5: Timing program of exposed to the air and exposed to the liquid Result of program can be seen at picture following.

Figure 6: Result of timing exposed to the air 15 second and exposed to the liquid 10 second.

Figure 7: Result of timing exposed to the air 10 second and exposed to the liquid 15 second

4.0 CONCLUSION

Have been made appliance prototype to control motor movement to the top and downwards used for reactor dye to be controlled with reach from under to the top is 15cm, with time of exposed to the air and exposed to the liquid earn variation from 1 to 20 minute.

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