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## FORMULATION OF A BIOCELLULOSE MASK CONTAINING THE ESSENCE OF ALOE VERA (L.) BURM.F COMBINATION WITH VITAMIN E AS ANTI-AGING

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*Most ageing processes are accelerated due to an increasing amount of endogenic stress from outdoor or indoor activity overload. The essence of aloe vera is formulated in the form of a biocellulose mask. It is one of the solutions to deliver essence within polymeric substances, obtained through the fermentation process with the help of *Acetobacter xylinum*.*

**The aim** of this study is to enhance anti-ageing activity derived from *Aloe vera* (L) essence combined with vitamin E, thus in the form of a biocellulose mask that will prolong skin contact and reduce the main cotton sheet mask problem of deforestation, hence its eco-friendly benefit.

**Material and methods.** Twelve volunteers around 25 to 45 years old are subjected to a biocellulose mask containing *Aloe vera* essence combined with vitamin E for at least 4 weeks to achieve a balanced skin criterion including wrinkles, spots, facial pores, and moisture. *Aloe vera* and vitamin E constituents within F0; F1, F2; F3, [0 %, 0 %]; [0 %, 1 %]; [5 %, 0 %] and [5 %, 1 %] as per the following.

**Results.** Results showed that bio-cellulose masks containing 5 % *Aloe vera* with 1 % of vitamin E essence in F3 provide a beneficial anti-ageing activity rather than other biocellulose mask preparations.

**Conclusion:** Biocellulose mask through the fermentation process can improve skin conditions, the formula combined with the well-known activity of *aloe vera* as an exfoliating agent and antioxidant vitamin E, it can not only provide skin rejuvenation but also provide anti-ageing activity

**Keyword:** *Aloe vera* (L.) Burm. f., anti-aging, biocellulose mask, vitamin E

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### 1. Introduction

The presence of free radicals, which are continuously produced either through metabolic processes or as a result of unfavourable environmental influences, causes ageing to be a normal process in human life [1]. Free radicals are one of the causes of premature ageing of the skin [2], and efforts to slow down premature ageing due to free radicals are antioxidants [3, 4]. Anti-ageing can help to slow down the ageing process. Cosmetics with anti-ageing or anti-ageing effects feature bioactivity that can prevent or improve indications of ageing, such as wrinkles, sagging skin, and hyperpigmentation, resulting in a more youthful appearance [5].

*Aloe vera* gel contains all kinds of polysaccharides, lignin, enzymes, vitamins, minerals, salicylic acid, and amino acids [6]. Many of these compounds, such as vitamins C and E, minerals like zinc and selenium, and non-essential amino acids like proline, can prevent premature ageing by making skin smoother, more moisturised, more elastic, and free of free radicals [7].

Vitamin E is one source of antioxidants. Because lipid cell membranes in the skin are constantly under attack from free radicals formed either in nor-

mal biological reactions or by various external factors, vitamin E has a protective function that is considered important to maintain the stability of biological membranes that contain large amounts of polyunsaturated fatty acids. Vitamin E-rich cosmetics are used on a daily basis to boost the skin's natural antioxidant capacity and battle oxidative stress. Vitamin E also aids in the prevention of UV damage symptoms such as wrinkles and uneven pigmentation [8]. Redox system acted as a process in signalling changes due to certain impairments within the body that lead to stress, and toxicity inducement, which would lead to tumour and cancer forming, combined with *Aloe vera* (L) and vitamin E as the main competition to increase antioxidant activity has been proven to had a beneficial effect in liver function in the decrease levels of AST and ALT levels and significantly as chemoprevention in decrement brain function [9, 10]

Cellulose is one of nature's most biodegradable substances. *Acetobacter xylinum* produces biocellulose as a byproduct of fermentation. When *Acetobacter xylinum* is cultivated on carbon and nitrogen-rich media, it creates biocellulose.

Sheet masks are typically constructed of nonwoven textiles, paper fibres, or biocellulose, all of which

absorb the essence. Biocellulose is derived from natural sources, such as bacteria, and is used to make sheet masks. Biocellulose masks are non-toxic and biodegradable, making them a good environmental choice. *Acetobacter xylinum* bacteria manufacture cellulose and generate acid from glucose. The pentose cycle is used by these bacteria to produce cellulose from glucose and similar substrates. According to recent research, cellulose derived from the bacteria *Acetobacter xylinum* contains long and fine fibrils and is heat stable [11, 12].

Essences are often used in the cosmetic industry. Consumers' changing lifestyle is why essences sell on the market. People, for example, desire to save time by simplifying their everyday cosmetic regimens. Because of the evolution of container design and the development of the functions of substances such as moisturisers and pharmaceutical compounds, the image that concentrates implies that the product has a better effect and is more convenient to use [13]. According to the above background, it is critical to conduct research into the anti-ageing and antibacterial benefits of acne-causing biocellulose masks, including aloe vera essence and vitamin E.

## 2. Planning (Methodology) of research

The method used in this research is the experimental method. This research includes the production of biocellulose mask sheets, the evaluation of biocellulose weight and thickness, the production of aloe vera essence and vitamin E, the evaluation of the physical quality of the preparation (homogeneity test, stability test, pH test, viscosity of the preparation), and the testing of the preparation's anti-ageing effectiveness.

### *Apparatus.*

Mortar and pestle, porcelain dish, analytical scale (Dickson), pH meter (Kedida), Stormer viscometer, skin analyser and moisture checker (Aramo Huvis), autoclave (Wisd), mask shape cutter, mask packaging sealer, and foil bag.

### *Material.*

*Acetobacter xylinum* starter, aged coconut water, ammonium sulphate, white sugar, acetic acid, aloe vera, vitamin E (dl-Tocopherol Acetate), glycerine, butylene glycol, xanthan gum, Na EDTA, sodium benzoate, phenoxyethanol, tween 80, PEG-40 Hydrogenated Castor Oil, citri oleum, spun bond.

## 3. Material and methods

### *Biocellulose Manufacturing.*

Acetic acid was added, along with white sugar, ammonium sulfate, and *Acetobacter xylinum* bacteria. The mixture was then poured into a mould, mixed until homogeneous, and then sealed. Incubation took place for three days at 30 °C [14].

The concentration of vitamin E used was 1 %, and the concentration of aloe vera juice used was 5 %. The basic formula of the mask without aloe vera juice and vitamin E was made as a blank. The formula for making masks can be seen in Table 1.

Table 1

Biocellulose Mask Formula

No.	Material	Amount			
		F0	F1	F2	F3
1	Vitamin E	–	1	–	1
2	Aloe vera essence	–	–	5	5
3	PEG- 40 Hydrogenated castor oil	3	3	3	3
4	Tween 80	5	5	5	5
5	Glycerin	5	5	5	5
6	Butylene Glycol	1	1	1	1
7	Xanthan Gum	0.2	0.2	0.2	0.2
8	Sodium Benzoate	0.5	0.5	0.5	0.5
9	Phenoxyethanol	0.3	0.3	0.3	0.3
10	Sodium Metabisulfite	0.1	0.1	0.1	0.1
11	Sodium EDTA	0.1	0.1	0.1	0.1
12	Oleum Citri	qs	qs	qs	qs
13	Distilled water	ad 100	ad 100	ad 100	ad 100

### *Procedure for Making Aloe Vera Essence and Vitamin E.*

Aloe vera and vitamin E were added after the ingredients for Tween 80, and PEG-40 Hydrogenated Castor Oil had been thoroughly blended. Glycerine was then stirred while the mixture was still thoroughly blended (mass I). When homogenous, Xanthan gum and butylene glycol were added (mass II). In demineralised water, sodium benzoate, sodium EDTA, sodium metabisulfite, and phenoxyethanol were dissolved (mass III). Mass II and mass III are combined to create a homogeneous solution (mass IV). Mass IV was added to mass I while stirring to create a homogeneous yellowish-hazy solution. Five drops of citri oleum were added as a perfume, and the mixture swirled until smooth.

### *Evaluation of Aloe Vera Essence and Vitamin E preparation.*

#### *Essence Preparation Stability with Cycling Test.*

Samples were stored at 4±2 °C for 24 hours, then transferred to an oven at 40±2 °C for 24 hours. This treatment was carried out for 6 cycles, Organoleptic data observed on the distribution and average value of particle size measurements were also taken (changes in colour, odour, shape, and phase separation) [15, 16].

#### *Essence Preparation Viscosity.*

A load is placed on the hanger, and the time required for the rotor to rotate 50 times is recorded.

### *Evaluation of Biocellulose Masks Containing Aloe Vera Essence with Vitamin E.*

#### *The pH of Biocellulose masks.*

A pH meter was utilised to measure the pH. A pH meter was used to determine the pH of a 1-gram sample in 100 ml of distilled water. The pH of the preparation is represented by the number displayed by the pH meter [17].

#### *Skin Irritation Test.*

Each volunteer underwent 24 hours of safety checks. Emerging symptoms are noted. Usually, a skin

reaction soon after sticking or contacting the skin will indicate irritation right away. Primary irritation describes this type of irritability. However, this irritation is referred to as “secondary irritation” if it happens several hours after touching and clinging to the skin.

*Anti-ageing activity testing on volunteers.*

Done on 12 female volunteers who were divided into 3 volunteer groups based on inclusion criteria, including women between the ages of 25 and 45, who had a relaxed skin analysis using a skin analyser, showed no evidence of early ageing, and had no previous history of skin allergies. And has been trained to refrain from using additional anti-ageing medications for 4 weeks. The measurement criteria include wrinkles, spots, facial pores, and moisture.

**4. Result**

*Essence Preparation Stability Test.*

Essence was kept for 24 hours standard time at a low temperature ( $4\pm 2\text{ }^{\circ}\text{C}$ ) inside a freezer and at for high temperature ( $40\pm 2\text{ }^{\circ}\text{C}$ ) inside of climactic chamber [18] (Fig. 1).

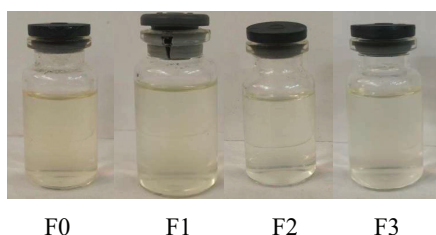


Fig. 1. From left to right, arranged are observations for each essence preparation after cycling tests F0, F1, F2, and F3

*Viscosity Test for Essence Preparation.*

sulting curve is a non-newton flow curve of the plastic flow type. Liquids with plastic flow will not flow until a particular force is overcome. The force is the yield value. The yield value is caused by the van der Waals interaction between adjacent droplets. At pressures below the yield value, the liquid acts as an elastic material, while above the yield value, the flow follows Newton’s law [21] (Fig. 2).

The following sample for each formula apparently did not follow the Newtonian law with a characteristic of the pseudoplastic fluid. However, it can be seen by the proof of its yield value. For a liquid/non-solid viscosity in the form of plastic or pseudoplastic flow, a certain pressure needs to be given for the subject to stream from one instance to another [22].

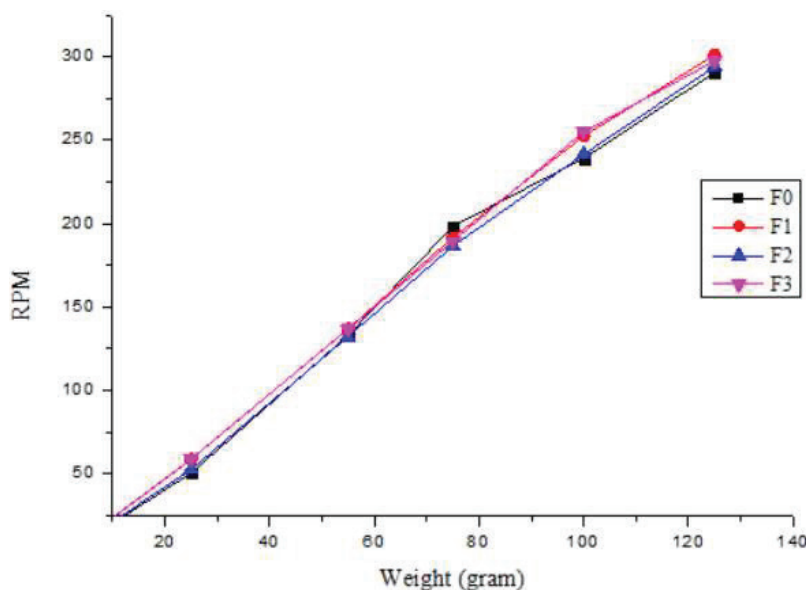


Fig. 2. Yield value for each formula with the Stromer viscosity method

Table 2

Viscosity test result for each essence formula

Weight	Rpm (Radian per Minute)			
	F0	F1	F2	F3
25	50.35	58.54	52.41	58.82
55	132.97	136.98	132.27	136.61
75	198.41	191.57	186.56	189.39
100	239.23	252.52	241.54	255.10
125	290.69	301.20	294.11	297.61

With the Stromer method, viscosity was measured for each essence formula, and the result can be seen in Table 2 to determine the value of the essence formula should follow or not the first Newtonian law [19].

Viscosity is a measure that states the viscosity of a liquid or fluid. Viscosity is a fluid property closely related to its resistance to flow [20]. In essence, the re-

*Biocellulose of aloe vera combined vitamin E essence for anti-ageing activity.*

*pH values biocellulose mask containing essence.*

Each square cut of biocellulose sheet mask from represented essence formulas was diluted in water after being stored for 12 weeks in room temperature pressure condition for acidity measurement and the value obtained for F0 (6.1); F1 (6.0); F2 (5.7) and F3 (5.9). pH measurement for each mask can still be considered viable because the acceptance range for the topical product must be within the range of 5–8 [23, 24].

*Skin Irritation Test.*

This test was performed on 12 females between the ages of 25 and 45, to be applied with a biocellulose sheet mask for 4 weeks. Results show that irritation occurrences such as rashes, itches, or boils are not present in volunteer facial conditions. Thus, it can be concluded that these sheet masks are safe for use [25, 26].

*Anti-ageing of biocellulose sheet mask.*

Good antioxidant testing greatly affects the effect of antioxidants on the skin [27]. Ageing activity

measurements from volunteers were achieved from the number of wrinkles forming, spots, facial pores, and moisture counts. The goal of this study was to see how far a biocellulose sheet mask containing aloe vera essence combined with vitamin E application could protect skin from ageing caused by free oxidative activity from either an extrinsic or intrinsic benefactor [2].

*Wrinkles forming measurement.*

Table 3  
Biocellulose sheet mask activity in decreasing wrinkles during 4 weeks of treatment

Formula	Before Application	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	Wrinkles measurement (%)
F0	**64	**62	**58	**56	**51	20.31
	**62	**62	**60	**57	**53	14.51
	**66	**66	**64	**62	**57	13.63
Mean	62	63.33	60.66	58.33	53.66	16.15
F1	**60	**57	**51	**47	**39	35
	**62	**58	**50	**45	**36	41.93
	**66	**62	**55	**49	**43	34.84
Mean	62.66	59	52	47	39.33	37.25
F2	**64	**60	**50	**42	**33	48.43
	**64	**60	**53	**47	**37	42.18
	**66	**62	**56	**48	**40	39.39
Mean	64.66	60.66	53	45.66	36.66	43.33
F3	**62	**55	**47	**38	**24	61.29
	**64	**58	**49	**35	**24	62.5
	**60	**52	**46	**33	**23	61.66
Mean	62	55	47.33	35.33	23.66	61.81

Note: Skin condition: \*\* – Intensive care needed, \*\*\* – Sufficient care needed, \*\*\*\* – Good skin condition, \*\*\*\*\* – Best skin condition.

Statically, there is a significant difference (p 0.05) shown in Table 3. In the moisture test for each volunteer gave good results, especially for formula (3), which consists of aloe vera essence of 5 % combined with vitamin E. Due to the increase in hydration of the skin from the coverage of the biocellulose sheet mask and the combined effect of aloe and vitamin E that improves skin elasticity and also provides collagen, preventing wrinkles from taking place [28].

*Spots.*

In Table 4 can be seen that the effect of a biocellulose mask containing aloe vera combined with vitamin E essence works wonders in decreasing spots counts in the subject’s facial area significantly (p<0.05), thus the effect from an antioxidant activity from vitamin E presence can prevent major harm from the sun’s ultraviolet ray that would lead to hyperpigmentation in the skin, especially for face area not only damage the surface but also impactful toward physiological effect [29, 30].

Table 4  
Biocellulose sheet mask activity in decreasing spots during 4 weeks of treatment

Formula	Before Application	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	Spots count (%)
F0	**45	**42	***38	***37	***33	26.66
	**43	***41	***38	***35	***31	27.90
	**42	***40	***37	***35	***30	28.57
Mean	43.33	41	37.66	35.66	31.33	27.71
F1	**44	***40	***36	***32	***26	40.90
	**46	**43	***37	***33	***28	39.13
	**43	***39	***33	***30	***25	41.48
Mean	44.33	40.66	35.33	31.66	26.33	40.50
F2	**42	***38	***33	***29	***22	47.61
	**43	***40	***35	***30	***25	41.86
	**45	***41	***37	***31	***24	46.66
Mean	43.33	39.66	35	30	23.66	45.37
F3	**44	***37	***31	***22	***15	61.36
	**45	***37	***30	***22	***16	64.44
	**42	***35	***28	***21	***14	64.28
Mean	43.66	36.33	29.66	21.66	15	63.36

Note: Skin condition: \*\* – Intensive care needed, \*\*\* – Sufficient care needed, \*\*\*\* – Good skin condition, \*\*\*\*\* – Best skin condition.

*Face pores.*

Table 5  
Biocellose mask activity in decreasing the size of the pores during 4 weeks

Formula	Before Application	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	Pores Decrement (%)
F0	***47	***43	***38	***35	***30	36.17
	***45	***41	***36	***31	***26	42.22
	***44	***40	***37	***33	***29	34.09
Mean	45.33	41.33	37.33	33	28.33	37.50
F1	***46	***43	***35	***30	***25	45.65
	***44	***40	***35	***27	***23	47.72
	***43	***38	***33	***26	***21	51.16
Mean	44.33	40.33	34.33	27.66	23	48.11
F2	***45	***38	***33	***26	***22	44.51
	***48	***42	***34	***30	***24	50.00
	***44	***39	***35	***28	***22	50.00
Mean	45.66	39.66	34	28	22.66	50.00
F3	***47	***42	***35	***27	***19	59.57
	***45	***40	***35	***26	***17	62.22
	***46	***37	***31	***25	***18	60.86
Mean	46	39.66	33.66	26	18	60.86

Note: Skin condition: \*\* – Intensive care needed, \*\*\* – Sufficient care needed, \*\*\*\* – Good skin condition, \*\*\*\*\* – Best skin condition.

In Table 5, for 4 weeks in treatment, significant improvement can be seen in F3, whilst for F2 decrease in

pores in size can be seen for prolonging treatment. Pores size may increase if the subject has a constant working condition under continuous sun exposure; if the increment should occur continuously may increase the chance of sebum which lead to acne forming on the face [31].

#### Improving Moisture.

In Table 6 increase in moisture after 4 weeks of treatment has proven beneficial from dry and scaly skin towards moister skin condition. With the help of prolonged activity with a biocellulose mask, it improves hydration within epidermis cells and improves the flow of essence that acts as an active substance, thus improving moisture in the skin significantly ( $p < 0.05$ ) [32].

Table 6  
Biocellulose sheet mask moisture improvement during 4 weeks of treatment

Formula	Before Application	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	Moisture Improvement(%)
F0	25	28	33	37	40	37.5
	23	27	31	35	39	41.02
	26	30	34	39	44	40.90
Mean	24.66	28.33	32.66	37	41	39.80
F1	28	33	41	45	50	44
	26	31	35	41	48	45.83
	25	32	40	44	50	50
Mean	26.33	32	38.66	43.33	49.33	46.61
F2	23	32	39	44	49	53.06
	25	33	40	46	51	50.98
	22	28	37	43	48	54.16
Mean	23.33	31	38.66	44.33	49.33	52.73
F3	25	35	41	50	58	56.89
	23	33	40	51	62	62.90
	22	29	39	48	54	59.25
Mean	23.33	32.33	40	49.66	58	59.58

Note : Dry/Low (<36); Dry/Normal (37–39); Normal/Normal (39–54); Hydrate (>55)

## 5. Discussion

This research is research that formulates a biocellulose mask preparation using aloe vera as an essence combined with Vitamin E as an anti-wind. This study uses aloe vera, which has many advantages as an essential ingredient. Aloe vera has antibacterial and anti-inflammatory properties, which are good for treating acne. The content of aloe vera, which has antibacterial properties, is an anthraquinone. Anthraquinone is an antibacterial compound whose working principle is the interaction of phenolic compounds with bacterial cells. This research was previously tested by Rani, 2020, testing the

manufacture of biocellulose sheet masks with the addition of loquat leaf extract as an antibacterial. What makes the difference between these studies is the use of essences, which increase skin moisture when applied to facial skin in particular so that skin does not get dry [14].

It is hoped that in the future, SEM (Scanning Electron Microscope) tests will be carried out on the preparations to see the biocellulose fibres on the resulting biocellulose mask sheet and that there will be further in vivo testing to test the effectiveness of the preparation.

**Research limitations.** In formulating sheet mask preparations, researchers often experience difficulties in printing the mask preparations, which is due to the presence of clumping that occurs due to the cold welding process, which makes the sample undergo a particle size fracture process; besides that, the problem is adjusting the pH of the preparation because the pH of the preparation is a parameter determinant of good preparation quality.

**Prospects for further research.** Sheet mask preparations are one of the most beneficial cosmetic preparations for humans. It is hoped that in the future, the use of cosmetic sheet masks will become more popular among the public to help maintain skin moisture and ensure that the skin is not easily exposed to free radicals due to excessive activity in the sun.

## 6. Conclusion

Biocellulose sheet masks obtained through the process of fermentation from bacteria can be considered a novel cosmetic delivery system as it can improve skin condition but also has eco-friendly benefits to prevent further deforestation. Combined with the well-known activity of aloe vera as an exfoliating agent and vitamin E antioxidant, not only could give skin rejuvenation but also provide a beneficial anti-ageing activity.

The biocellulose sheet mask obtained through the fermentation process from *Acetobacter xylinum* can be considered a new cosmetic delivery system. Because it not only improves skin condition but also has eco-friendly properties that help prevent further deforestation; combined with the well-known activities of aloe vera as an exfoliating agent and antioxidant vitamin E, it provides skin rejuvenation but also acts as a skin moisturiser.

## Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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