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Formulation and Evaluating Anti-Aging Effect of Vitamin E in Biocellulose Sheet Mask

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Abstract : Facial mask is popular facial-care product amongst consumers, especially the one that contains vitamin E as anti-aging. Face mask is easy to use, and it has a better active-ingredient penetration effect. Biocellulose is a natural cotton-mask replacement which is more eco-friendly with higher occlusive effect. The aim of this research is to formulate a biocellulose mask with vitamin E as anti-aging and to evaluate its effectiveness against volunteer's facial skin.The evaluation conducted to the biocellulose mask include the mask's weight and thickness. Essence evaluation includes homogeneity test, viscocity test, pH test, stability test, irritation test and anti-aging effectivity test using skin analyzer. Parameters measured include moisture, evenness, pore, spots, and wrinkles. The results showed that biocellulose could be formulated as a facial mask preparation and higher vitamin E concentration in the essence result in a better anti-aging effectiveness.
Keywords : *Biocellulose mask, vitamin E, acetobacter xylinum, anti-aging, formulation, skin analyzer.*

Introduction

Aging is a natural process in human life that continously affected by free radical formed by metabolism process or enviroment pollutions[1].Sign of aging can be detected in every organ in human and the most visible sign is skin aging[2]. Signs of aging in skin are wrinkle, dry skin, and dark spot[3].

One of antioxidant source are vitamin E; it protects lipid membrane in the skin from damagecaused by free radicals. Daily use of cosmetics that contain vitamin E could strengthen natural antioxidants in the skin and overcome oxidative stress[4].

Sheet mask is one of the latest and newest trend which is popular in Asia. Compared to another form of the masks, sheet mask has Occlusive Dressing Treatment (ODT) mechanism which has a good absorption and penetration profile, efficient and hygienic (disposable) packaging, and does not need to be cleaned after usage[5].Sheet mask is a type of mask that is made of non-woven, pulp, biocellulose, etc. It has excellent sealing properties which can improve the effects of active substances in moisturizing, whitening, anti-aging and other aspects[6].

In this cosmetic mask pack sheet, a non-woven fabric made of either plant cellulose fiber (derived mainly from cotton or pulp) or synthetic fiber. In addition to fibernon-woven fabric, various and unique materials may be used to support the cosmetic emulsion, touch feeling and effect in thecosmetic mask pack

sheet.[7]Furthermore, studies on variousmaterials have been conducted to improve the touch and wearing sensation, and effect of the cosmetic mask pack sheet[8].

Cellulose masks obtained from natural sources, suchas bacteria, are of interest because of their low toxicity andbiodegradable properties. *Acetobacter xylinum*, a bacterium, can produce acid from glucose and synthesize cellulose. It creates cellulose from sugars and related substrates via thepentose cycle. Bacterial cellulose has been widely used asa stabilizer in foods and cosmetics. In the form of a film, itcan be used in surgical procedures and for dental implants.Recently, bacterial cellulose obtained from *Acetobacter xylinum* culture was found to be composedof long, smooth, and oriented fibrils and to exhibit considerablethermal stability. Therefore, the author is interested to make a research about anti aging effect of vitamin E in biocellulose mask[9].

Experimental

Apparatus

Laboratory glassware (Pyrex), Brookfield viscometer, pH meter (Eutech Instrument),Skin Analyzer (Aramo), Laminar Air Cabinet (NUAIRE), Autoclave (Wisd), Glass mould, and Facial face mask's cutter.

Material

Acetobactre xylinum stater, Vitamin E (dl α-Tocopherol Acetate), Gylcerin, Polysorbate 80, PEG-40 Hydrogenated Castor Oil, Butylene glycol, Amonium sulfate, Xanthan gum, Sodium EDTA, Sodium Benzoate, Phenoxyethanol, Old coconut water, Sugar, Acetic acid 20%, Non woven facial mask's shape, Demineralized water, Foil bag, and Oleum citri.

Preparation of biocellulose sheet mask

The components of the biocellulose sheet maskpreparation were shown in Table 1.

Making process

Old coconut water are weighed and heated at a temperature of 80°C for up to 15 minutes. Then it iscooled down whilewhite sugar and ammonium sulfate were added. After that, acetic acid was added to the solution until it reaches pH 4. Starter bacteria *Acetobacter xylinum* is added to a solution that has been colled down, stirred homogeneous, placed in a glass mold and covered with parchment paper to avoid contamination. The incubation process is carried out for 2-3 days at 30°C[10]. In this experiment the incubation process is carried out for 30 hours at a temperature of 27-30^{o}C.

Cleaning Process

Biocelulose which has been completed is taken out of the mold glass, washed with running water and cleaned the cuticle at the bottom of the sheet biocellulose. Then it is boiled in boiling water for up to 30 minutes. After soaking in a hot solution of NaOH of 0.5% for 15 minutes, it was washed in running water and soaked with distilled water for 1 day to neutral pH[11].

Cutting Process

Cleaned and neutralized pH biocellulose is placed on glass plates for the cutting shape of the face mask. The mask is then washed clean.

Table 1. Formula of biocellulose sheet mask

No	Material	Concentration (%)
1	*Acetobacterxylinum*Starter	10
2	White sugars	4
3	Acetic acid 20%	2,5
4	Ammoniumsulfate	0,5
5	Old coconut water	83

Preparation of biocellulose sheet mask's essence

The components of the formulation were shown in Table 2.

Tween 80 and PEG-40 hydrogenated castor oil was mixed with vitamin E until homogenized then glycerin was added (mixture 1). Xanthan gum was dispersed with butylene glycol (mixture 2). Sodium benzoate, metabisulfite, sodium EDTA and phenoxyethanol were dissolved in demineralize water (mixture 3). Admixed mixture 2 and mixture 3 until it is homegenized, than slowly poured into mixture 1 and homogenized slowly.

Packaging of Biocellulose Sheet Mask

Before packaging process, biocellulose mask was sterilized with autoclave in 30 minute at 121^{o}C and cooled down until 30^{o}C. Packaging process had been done in laminar air cabinet (LAC), biocellulose mask had layered with nonwoven sheet to hold the surface texture. The biocellulose mask had hand pressed with two plate of thick glass to drained the water content in biocellulose mask. Fold the biocellulose and put into foil bag, weighed 35 g essence mask and then poured into a foil bag. Sealed foil bag with sealing tools and label it.

Table2.Formula of biocellulose sheet mask's essence

No	Material	Ammount(g)				
		F0	**F1**	**F2**	**F3**	**F4**
1	Vitamin E	-	-	1	3	5
2	PEG-40 *Hydrogenated castor oil*	3	3	3	3	3
3	Tween 80	5	5	5	5	5
4	Glycerin	-	5	5	5	5
5	Butylene Glycol	-	1	1	1	1
6	*Xanthan Gum*	0.2	0.2	0.2	0.2	0.2
7	Sodium Benzoate	0.5	0.5	0.5	0.5	0.5
8	*Phenoxyethanol*	0.3	0.3	0.3	0.3	0.3
9	Sodium Metabisulfite	0.1	0.1	0.1	0.1	0.1
10	Sodium EDTA	0.1	0.1	0.1	0.1	0.1
11	Oleum Citri	5 drop	5 drop	5 drop	5 drop	5 drop
12	Demineralized water	90.8	84.8	83.8	81.8	79.8

Physical Quality Evaluation of the Preparation

Biocellulose Physical Evaluation

The thickness, weight and after hand-pressed weight of produced biocellulose are going to be evaluated. The thickness of biocellulose mask ismeasured using a micrometer screw. Theweight of biocellulose mask measured with wetand hand pressed weight biocellulose mask. The measurements of thickness and weight are done on three different masks, the results are averaged.

Homogeneity test

A certain amount of preparations were applied on a piece of glass or other suitable transparent material, preparations should show a homogeneous composition and no visible coarse grains.

pH measurements

Determining pH of the preparation is done by using a pH meter. Instrument must first be calibrated using pH neutral buffer solution (pH 7.01) and acidic pH buffer solution (pH 4.01) until the instrument shows the pH values. Then, washed the electrode with distilled water then dried with paper towels. Place the electrode in the essence, pH of the essence appears in the display.

Viscosity measurements

Determination of viscosity is made by using a Brookfield viscometer with 62 as the number of spindle and 12 as the speeds.

Stability test

A total of 100 grams of each formula were put into plastic pots. Furthermore, the observations are in the form of changes in consistency, color and scent at the time of the preparation is finished as well as in storage for 12 weeks at room temperature.

Irritation test

Irritation test conducted on 15 volunteers with patch test technique by attaching the preparation on the back of the ear.

Anti-Aging Effect test

Using AramoSG®skin diagnosis system. Treatment conducted for 4 weeks by applying the mask once a week. Parameters measured including moisture, evenness, pore, spot and wrinkles. Each formula consists of 3 volunteers.

Volunteer

15 volunteerswere used to conduct this experiment who has been analysed before hand for having signs of premature aging, such as dry skin, wrinkles and black spots.

The criteria of volunteers are :

1. Women
2. Age between 20-25 years
3. No medical history associated with allergies.

Results and Discussion

Physical Quality Evaluation of Biocellulose sheet mask and vitamin E essence

The results of biocellulose sheet mask and vitamin E essence preparation and physical quality evaluation were shown in Figure 1, Figure 2, Table 3, and Table 4.

Figure 1. Biocellulose Sheet Mask

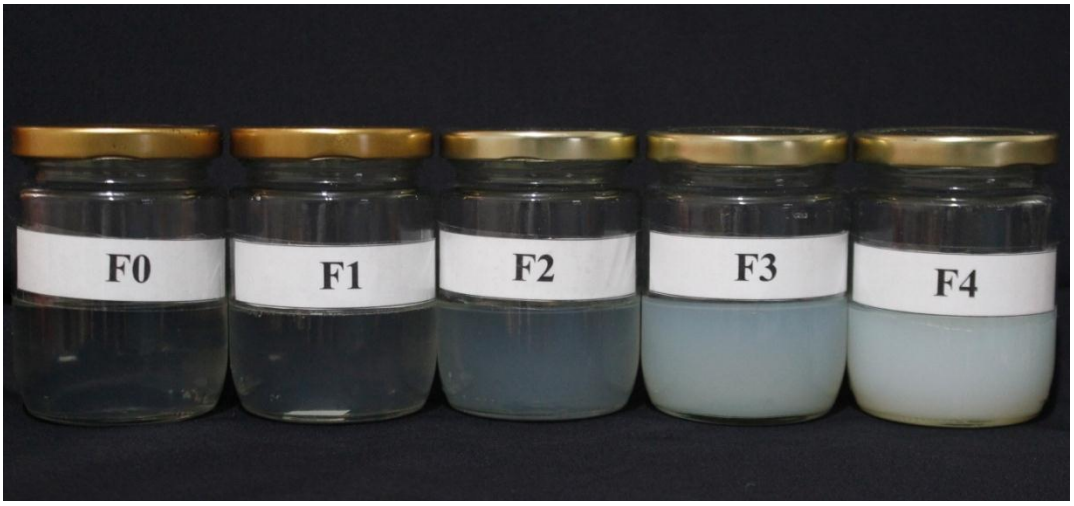

Figure2. Vitamin E Sheet Mask's Essence

Note:

F0: negative control sheet mask's essence
F1: positive control sheet mask's essence
F2: 1% vitamin E sheet mask's essence
F3: 3% vitamin E sheet mask's essence
F4: 5% vitamin E sheet mask's essence

Table 3. Physical quality evaluation of biocellulose mask

Biocellulose mask	Wet weight (g)	Hand pressed Weight (g)	Water hold capacity (%)	Thickness (mm)
1	172.72	25.21	85.40	1.25
2	183.51	28.53	84.45	1.10
3	174.28	27.47	84.20	1.30
Average	176.84	27.07	84.70	1.22

Table 4.Physical quality evaluation of vitamin E essence

Parameter	Formula				
	F0	F1	F2	F3	F4
Homogeneity	✓	✓	✓	✓	✓
pH	6.7	6.56	6.46	6.39	6.31
Viscosity (cps)	360	375	387,5	400	425
Stability	Stable	Stable	Stable	Stable	Stable
Irritation	-	-	-	-	-

Note: ✓ = homogeneous, - = no irritation

The biocellulose mask thickness and weight data on Table 3 shown that the average biocellulose mask's thickness was 1.22 mm, and the biocellulose wet and hand pressed weight was 176.84 g and 27.07 g. The water hold capacity was 84.70%. This shown that biocellulose have a high hidrophilic properties. If the biocellulose water content below 5% or less than one time of dry biocellulose, it will decrease the hydrophilic properties[12].Because the hydrogen bond in biocellulose form a covalent bond between them due to the lack of water content that bond with it[13].In this study, the biocellulose mask was hand pressed to obtain the constant weight that contains 15% water content. Because it is the best way for biocellulose mask to absorbthe essence.

The data in Table 4 above shows that each formula was homogeneous.The pH value was 6.31-6.70 which iswithin the range of permitted pH requirements for cosmetics (5-8).Viscosity valuefor each formuladid

not undergo changes during storage. Each formula were stable during storage and were non-irritating to the skin and it can be said that the overall preparation sheet masks are safe to use.

Anti-aging test

The anti-aging effect of vitamin E between in biocellulose sheet mask on volunteers' skin were shown in Figure 3, Figure 4, Figure 5, Figure 6, and Figure 7.

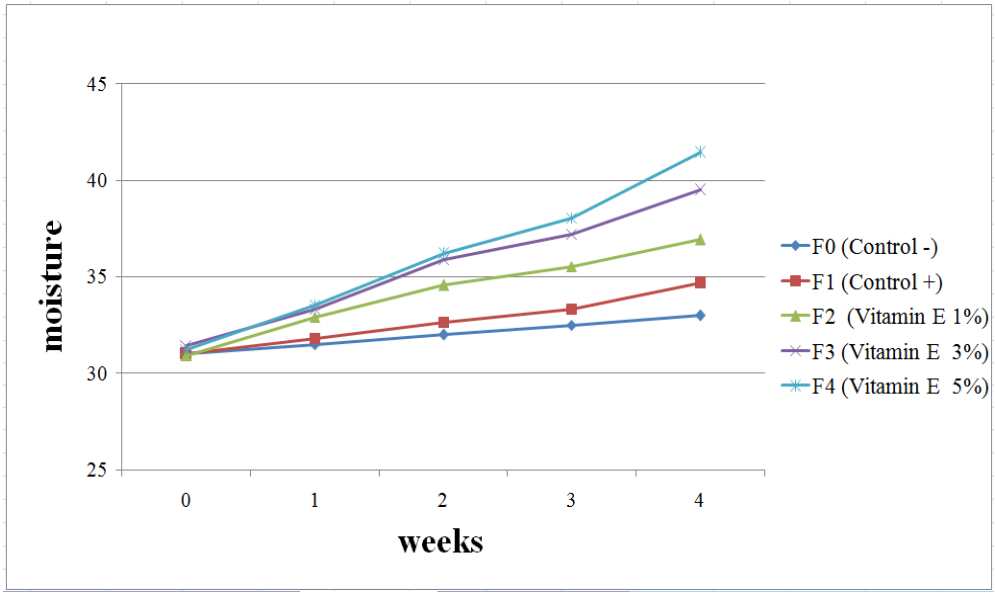

Figure 3. Improvement of moisture in 4 weeks treatment

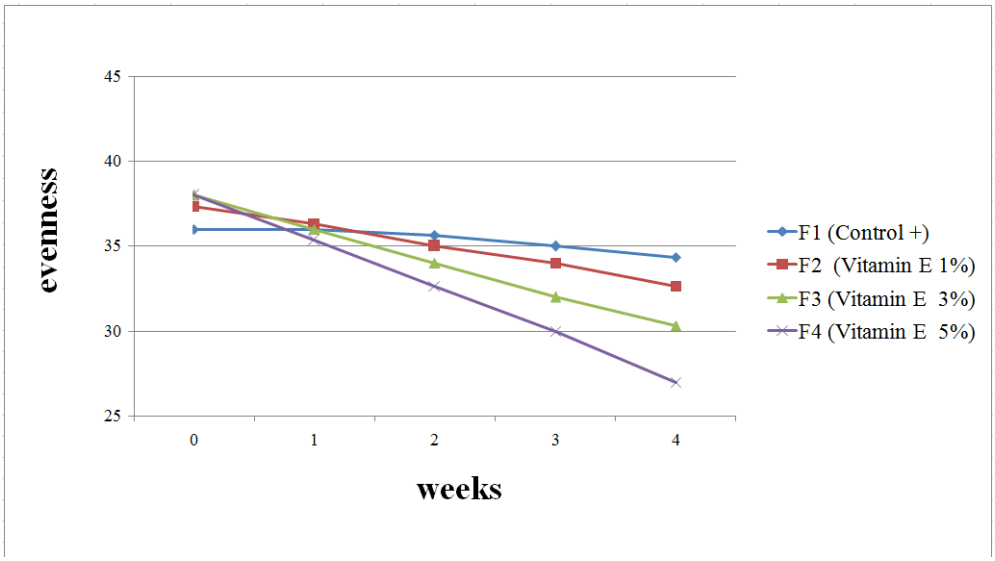

Figure 4. Improvement of evenness in 4 weeks treatment

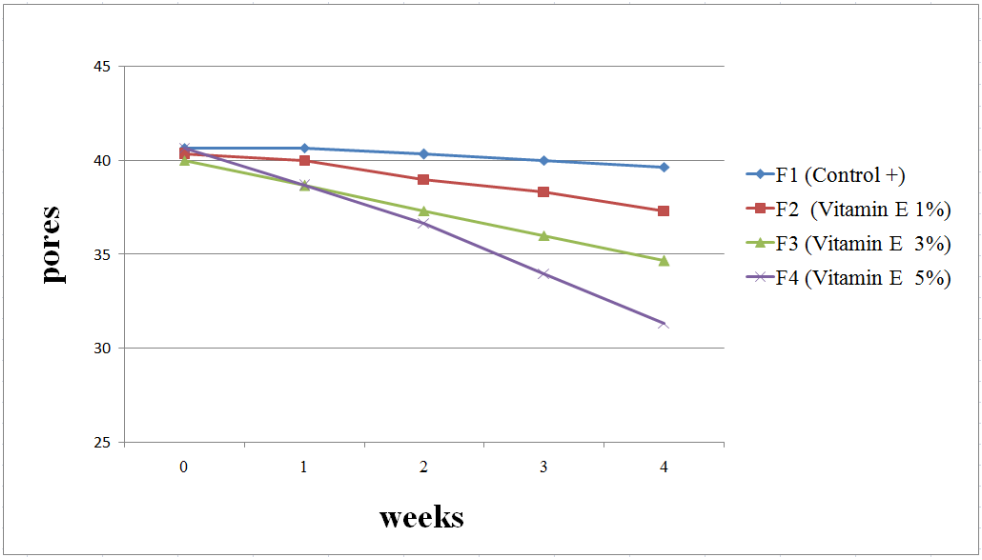

Figure 5. Improvement of pores in 4 weeks treatment

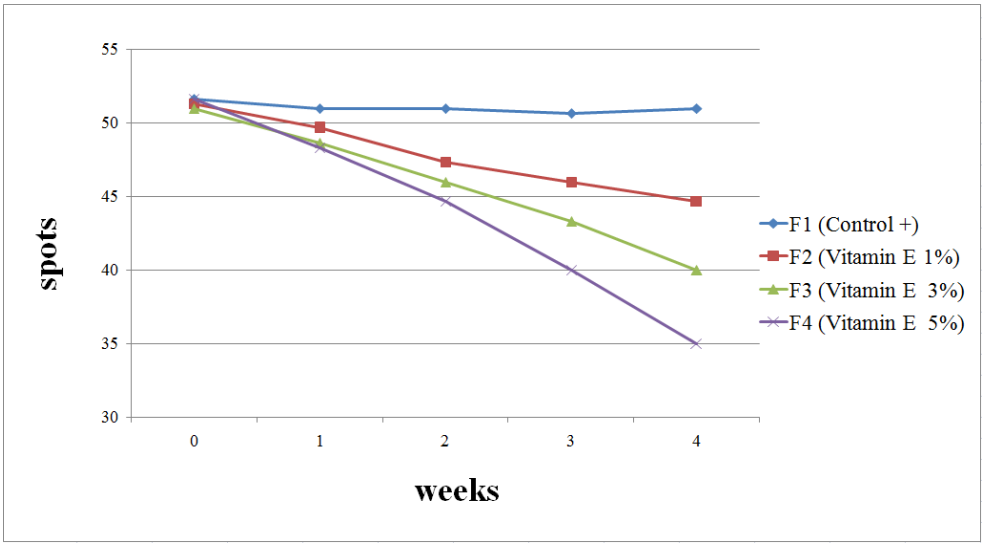

Figure 6. Improvement of spots in 4 weeks treatment

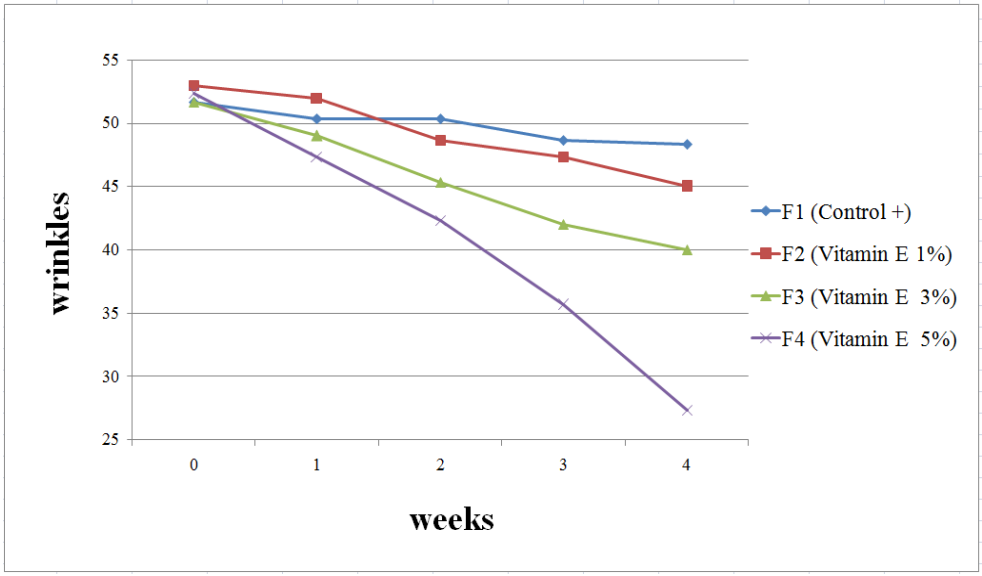

Figure 7. Improvement of wrikles in 4 weeks treatment

Moisture

α-tocopherols act as radical scavengers to prevent oxidative degradation of Hyaluronic Acid. In tissue culturesystems, the addition of Vitamin E to the medium prevents spontaneous degradation of Hyaluronic Acid. The function of Hyaluronic Acid in human skin is to moisturize skin to prevent dryness[14].

In 4 weeks of treatment, biocellulose with essence formula F0 (blank -) that not have a humectants also increasing the moisture content it because, the human skin can absorp moist from biocellulose mask, it's cause by the high concentration gradient ofwater between biocellulose mask and human skin, so it's makes skin moisture increase. The biocellulose also can absorbs moisture from the environtment and retaining skin moisture. The occlusive effect of the biocellulose mask administered to facial skin can reduces transepidermal water loss[9].

Evenness

Vitamin E in the skin function to help improve the structure of skin, preventing premature aging, nourish the skin and smoothes the skin's surface. Vitamin E protects the stratum corneum proteins from oxidation and peroxidation of lipids that help maintain the structure of the membrane of the skin so that skin smoothness continue to rise[15].

Pores

Pores may be enlarged if exposed to the sun is too hot, the increase in temperature causes a magnification of pores in the skin, so the buildup of dead skin cells (dirt) can trigger acne as well as affect the pore size, vitamin E can release the dead skin cells and stimulate the formation of new cells and can capture free radicals that damage the skin, so as to shrink the pores of the skin[16].

Spots

Hyperpigmentation is a condition in which melanin is synthesized excessively. This occurs because ofexposure to sunlight (UV rays) so the melanocyte cells initiate the synthesis ofmelanin. Increased synthesis ofmelanin results in dark spots on the skin[17].

Vitamin E and its derivatives inhibit tyrosinase in vitro and melanogenesis in epidermal melanocytes. The antioxidant properties of Vitamin E, which interferes with lipid peroxidation of melanocyte membranes and increases theintracellular glutathione content, could explain its depigmenting effect. Alpha-Toc has amore effective and long-lasting antioxidant response. Vitamin E inhibited melanogenesis in cultured normal human melanocytes, although itdid not influence melanin synthesis in enzyme solution prepared as cell homogenates. Inaddition, Vitamin E stimulated intracellular glutathione (GSH) synthesis[18].

Wrinkles

Vitamin E is used in cosmetics for everyday use to strengthen the natural antioxidantpotency of the skin and thus to better cope with oxidative stress. Vitamin E acts on the inside and reduces therisk of damage that could be caused by rays passing through the sun filter barrier. VitaminE helps, therefore, in the prevention ofsymptoms caused by UV-induced skin damagesuch as wrinkling and irregular pigmentation[19].

Wrinkles are creases in the skin that develop with advancing age, due to the skin’s loss of collagen,whereby its elasticity and structure begins to cede. This phenomenon relates to the whole body but, principally,the face, neck, neckline and hands – the areas of the body exposed to the sun and the damaging effects of UVrays[4].

Conclusion

Results indicate that vitamin E in biocellulose mask derived from Acetobacter xylinum can give an anti-aging effect on increasing skin moisture and evenness; reducing pores size, spots, and wrinkles. The higher concentration of the vitamin E in biocellulose mask essence can enhance the effect of anti-aging.

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