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The Comparison of Skin Wrinkle Reduction Effects Between Hydrogel Mask Containing L-Ascorbic Acid Entrapped in Sacran Polymer and Standard Hydrogel Mask Containing L-Ascorbic Acid in Healthy Adult

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Abstract

Sacran is used in skincare for its moisturizing benefits, and L-Ascorbic acid (LAA) is a popular antioxidant commonly used in skincare products. However, while the benefits of LAA are well known, its susceptibility to degradation is a concern. Currently, no research has compared the efficacy of a hydrogel mask containing LAA entrapped in Sacran polymer with a standard hydrogel mask containing LAA for anti-aging, moisturizing, and brightening. The objectives of this study are to assess the clinical efficacy of LAA-incorporated Sacran hydrogel in addressing concerns related to anti-aging, moisturizing, and brightening, particularly in the context of frontal lines. Additionally, we aim to compare its performance with that of LAA in standard hydrogel masks containing LAA, which is a conventional dosage form. This study involved 16 healthy Thai volunteers (aged 25-49 years) in a single-blind, split-face trial. The researcher compared the LAA-incorporated Sacran hydrogel mask with a standard hydrogel mask containing LAA. Both male and female participants with shallow to deep wrinkles were assessed. All volunteers received both masks to compare efficacy, with measurements taken at the first visit, the 2nd week, and the 4th week (end of the experiment). The results showed a significant increase in moisturizing from week 0 to week 4 and from week 2 to week 4 ($p = 0.001$). However, while the brightening value and wrinkle reduction were not statistically significant, there was a trend toward

increased brightening and reduced wrinkles compared to the standard hydrogel mask containing L-Ascorbic acid.

Keywords: Sacran, L-Ascorbic Acid, Hydrogel Mask, Entrapped, Moisturizing, Brightening, Anti-Aging

Introduction

Nowadays, consumers tend to take care of themselves, including taking care of their skin. Thai people that still take attention to the image. Having good, smooth, and youthful skin It can also promote confidence in the owner. Therefore, causing consumers to turn their attention to skincare and treatment to promote self-confidence.

We are well aware of the benefits of L-Ascorbic acid (LAA) and its susceptibility to degradation. Encapsulating LAA within Sacran polymer to form a hydrogel can help preserve the effectiveness of LAA until it reaches the end-users. Moreover, developing a stable, effective LAA hydrogel would significantly advance the skincare industry, as it offers a novel approach to formulation stability and sustained efficacy. If successful, this research could lead to new product innovations, ultimately benefiting consumers by providing longer-lasting, high-performance skincare solutions. The objectives of this study are to assess the clinical trial of the efficacy of LAA-incorporated Sacran hydrogel in addressing concerns related to anti-aging, moisturizing, and brightening, particularly in the frontal Line context. Additionally, we aim to compare its performance with that of LAA in standard hydrogel masks containing L-Ascorbic acid, which is a conventional dosage form.

Research Methodology

1. Study Design

This was a clinical trial, single-blind by researcher, compare with standard hydrogel mask containing L-ascorbic acid, split face study in male and female. Thai volunteers with shallow to deep wrinkles assessed scores. All volunteers received both masks (Right = Hydrogel Mask Containing L-Ascorbic Acid Entrapped In Sacran Polymer, Left = Standard Hydrogel Mask) for compare efficacy and received measurements at the first visit, the 2nd and 4th week (end of experiment). All volunteers apply both mask 3 time/week on Monday, Wenday, and Friday. The side effects and volunteers were also evaluated.

2. Study Population

Thai volunteers, aged 25-50 years old with facial wrinkles.

Students at Mae Fah Luang University's school of Anti-Aging and Regenerative Medicine.

3. Sample

Male and female, Thai volunteers and studying in the School of Anti-aging and regenerative medicine at Mae Fah Luang University with shallow to deep wrinkles assessed scores. They received the measurements at Mae Fah Luang Hospital, Bangkok during in July 2024. After the research was approved by the MFU Ethics Committee under code No. EC 24052-20.

4. Sample Size Determination

The sample of 15 volunteers, if the allowance of 10% for drop out, then the corrected sample is 17 volunteers.

5. Study Location

Mae Fah Luang University, Bangkok

6. Materials and Equipment

1) The information sheet
2) The informed consent
3) The record form of the research result and side effects of the treatment
4) The questionnaire for Volunteers' satisfaction and evaluation
5) The permanent marker
6) Facial cleansing agent: Gentle Cleanser
7) The Visioscan® vc98 for wrinkle assessment
8) Corneometer® for moisturizer assessment
9) Mexameter MX18 for amount of melanin assessment
10) The hydrogel mask containing L-ascorbic acid entrapped in Sacran Polymer is composed of L-ascorbic acid, sacran, trehalose, ferulic acid, and water. Enclosed in a light-protected container, the mask initially appears as a colorless dry film, which is subsequently immersed in water to transform into a colorless hydrogel form. The pH of the hydrogel mask is approximately 3-5. This product was manufactured under the oversight of Cosmetic Science Laboratories at Mae Fah Luang University.

11) The standard hydrogel mask containing L-ascorbic acid is composed of L-ascorbic acid, standard polymer such as PVA and PVP, trehalose, ferulic acid, and water. Enclosed in a light-protected container, the mask initially appears as a colorless dry film, which is subsequently immersed in water to transform into a colorless hydrogel form. The pH of the hydrogel mask is approximately 3-5. This product was manufactured under the oversight of Cosmetic Science Laboratories at Mae Fah Luang University.

7. Data Analysis

1) Analyze qualitative data, for example, gender, occupation, history of use anti-wrinkle, brightening, and moisturizing product, side effects, and satisfaction. The results were presented as numeric data and percentage.

2) Skin analysis was measured before, week 2 and after the experiment, comparing differences using the Repeated measure ANOVA. Results were collected as mean change and SD, with a statistical significance value set at $P<0.05$.

8. Ethical Conceptualization

This research was submitted for ethical review in March and was approved on June 27, 2024, by the MFU Ethics Committee under code No. EC 24052-20.

Result

The mean age of volunteers was 28.75 ± 6.74 ranging from 25 to 49 years old. There were 5 males and 12 females participating in this study. They have worry facial problem consisted of 17 dull, 16 dark sport/scars, 17 dehydrate, 14 wrinkle, 9 acne, 7 irritation, 2 itchy rash, and 6 redness skin. They had facial treatment routine consisted of 6 volunteers received treatment from expert in routine and 6 volunteers used hydrogel mask before. And they use facial skincare routine consisted of 1 the ingredients have Sacran, 8 whitening, 14 moisturizing, 6 anti-aging, 8 LAA, and 16 sunscreen skincare.

Table 1 Comparison of the average brightening values between weeks 0, 2, and 4 (end of experiment), and comparison between the hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer and the standard hydrogel mask containing L-Ascorbic acid at the same time. (n=16)

Mask Type	Week 0		Week 2		Week 4		p-value
	Mean	SD	Mean	SD	Mean	SD	
Test*	245.67	39.13	240.06	42.62	235.04	39.62	0.573
Standard**	236.75	43.69	244.42	39.31	244.65	37.68	0.616
p-value	**0.217**		**0.511**		**0.108**		

Note P-value from Repeated Measure ANOVA

* Hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer

** Standard hydrogel mask containing L-Ascorbic acid

Table 2 Comparison of the average moisturizing values between weeks 0, 2, and 4 (end of experiment), and comparison between the hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer and the standard hydrogel mask containing L-Ascorbic acid at the same time. (n=16)

Mask Type	Week 0		Week 2		Week 4		p-value
	Mean	SD	Mean	SD	Mean	SD	
Test*	49.87	14.02	52.68	15.58	70.60	13.64	0.001
Standard**	48.65	21.83	55.04	14.64	64.96	10.95	0.059
p-value	**0.793**		**0.514**		**0.057**		

Note P-value from Repeated Measure ANOVA

* Hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer

** Standard hydrogel mask containing L-Ascorbic acid

Table 3 Change of skin moisturizing after use hydrogel mask (n=16)

Week	Moisturizing	
	Test**	
	$\bar{x}$ ± SD	P
Week0-2	-2.80±3.03	1.000
Week0-4	-20.72±4.55	0.001
Week2-4	-17.92±4.03	0.001

Note P-value compared with the value before use hydrogel mask

** Hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer

Table 4 Wrinkle information

Wrinkle characteristics	Total
	n
Wrinkle Assessment Scale	
Score 1: Shallow, just perceptible wrinkle	15
Score 2: Moderately deep wrinkle	2
Apply Anti-aging Skincare	
Use	6
None	11
Apply Sunscreen	
Use	16
None	1

Table 5 Comparison of the average wrinkle values between weeks 0, 2, and 4 (end of experiment), and comparison between the hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer and the standard hydrogel mask containing L-Ascorbic acid at the same time. (n=16)

Mask Type	Week 0		Week 2		Week 4		p-value
	Mean	SD	Mean	SD	Mean	SD	
Test*	70.01	25.35	63.47	19.47	57.23	15.55	0.021
Standard**	76.87	22.23	59.93	13.63	60.83	13.53	0.019
p-value	**0.417**		**0.459**		**0.510**		

Note P-value from Repeated Measure ANOVA

* Hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer

** Standard hydrogel mask containing L-Ascorbic acid

Table 6 Change of skin wrinkle after use hydrogel mask (n=16)

Week	Wrinkle			
	Standard*		Test**	
	$\bar{x}$ ± SD	P	$\bar{x}$ ± SD	P
Week0-2	16.94±5.03	0.013	6.54±7.83	1.000
Week0-4	16.01±6.66	0.088	12.78±4.35	0.031
Week2-4	-0.89±4.07	1.00	6.24±5.86	0.912

Note P-value compared with the value before use hydrogel mask

* Standard hydrogel mask containing L-Ascorbic acid

** Hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer

Satisfaction of Volunteers

The volunteers were asked to complete the questionnaire about their feelings after use hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer and standard hydrogel mask containing L-Ascorbic acid. The result was shown in Table 7 that the volunteers in the test group and standard group felt relaxed, sticky, penetrative, brightening and wrinkle effect after use hydrogel mask at a good level. The smell, overall quality, moisturizing, and satisfy after use hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer at an excellent but in standard hydrogel mask containing L-Ascorbic acid at a good.

Table 7 Satisfaction of volunteers after use hydrogel mask (n=16)

Factor	Test*	Levels of satisfaction	Standard**	Levels of satisfaction	P
	$\bar{x}$ ± SD		$\bar{x}$ ± SD		
Relaxation	3.88±0.96	Good	3.75±0.86	Good	0.598
Smell	4.19±0.83	Excellent	3.88±0.81	Good	0.713
Sticky	3.31±1.35	Good	3.88±1.20	Good	0.441
Penetrative	3.81±0.98	Good	3.63±1.02	Good	0.671
Overall Quality	4.00±0.82	Excellent	3.94±0.77	Good	0.823
Brightening	3.63±0.96	Good	3.56±0.89	Good	0.746
Moisturizing	4.06±0.77	Excellent	3.88±0.72	Good	0.813
Wrinkle	3.56±1.03	Good	3.50±0.89	Good	0.495

Table 7 (continued)

Factor	Test* $\bar{x}$ ± SD	Levels of satisfaction	Standard** $\bar{x}$ ± SD	Levels of satisfaction	P
Satisfy after use hydrogel mask	4.25±0.86	Excellent	4.06±0.85	Excellent	0.748

Note $\bar{x}$ = mean difference

* Hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer

** Standard hydrogel mask containing L-Ascorbic acid

Discussion and Suggestion

1. Discussion

1) General Characteristics

There were 16 volunteers who completed the study. The mean age of volunteers was 28.75± 6.74 ranging from 25-49 years old. The number of male volunteers was more minor than females. They have history use moisturizing, whitening, anti-aging, L-ascorbic acid and sunscreen in skincare routine.

2) Brightening Effect

From this study show after use hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer in 4 weeks trend to decrease melanin value but not significantly. It may have happened because the research period coincided with a holiday. Possibility some volunteers received UV more than normal.

However, after use hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer the melanin value was trend to decrease mean Sacran polymer can kept stability of LAA effective than standard hydrogel.

A previous study found L-ascorbic acid, is a well-known antioxidant that dermatologists apply topically to cure and prevent photoaging and hyperpigmentation. Through its interactions with superoxide, hydroxyl, and free oxygen ions, that prevents inflammation, cancer, and other factors that accelerate photoaging while also neutralizing free radicals. L-ascorbic acid functions as a cofactor in the hydroxylation process and is necessary for the formation of collagen. Additionally, according to Markiewicz-Tomczyk et al. (2022), it plays a role in skin depigmentation and inhibition of melanogenesis, making discolorations less visible. It also helps seal blood vessels and prevents telangiectasia.

3) Moisturizing Effect

Both of hydrogel mask show that can increase moisturizing value. And the hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer's side in week 0 to week 4 and week 2 to week 4 was significant ($P<0.05$). It is possible that this effect is because Sacran can provide high moisture because This is about 5 times the power of microbially derived hyaluronic acid, a common moisturizing agentused in cosmetics (Doi et al., 2017).

A previous study by Kwon (2020) showed that a hydrogel mask can increase skin moisturization when applied three times a week for four weeks. Additionally, Okan and Rendon (2011) conducted a clinical trial with 15 female participants, aged 45-72, who had facial wrinkles and skin types 2 and 3. All participants underwent full-face laser resurfacing using an Er laser. The use of a hydrogel mask post-procedure decreased postoperative morbidity, shortened epithelial healing time, relieved immediate pain, and prevented crust formation and itching.

4) Anti-aging Effect

This study shows both of hydrogel mask trend to decrease but the hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer's side was significant ($P<0.05$) in week 0 to 4 because L-Ascorbic Acid is an antioxidant drug that is used topically in dermatology to treat and prevent the changes associated with photoaging, as well as for the treatment of hyperpigmentation (Markiewicz-Tomczyk et al., 2022). In addition, an adequate amount of water is important for a healthy, smooth, and flexible skin appearance (Westermann et al., 2020).

However standard hydrogel mask containing L-Ascorbic acid increase a little bit in week 2 to 4. This may happen because the research period coincided with a holiday. Possibility some volunteers received UV more than normal.

A previous study by Quattrone et al. (2017) conducted a clinical trial to assess the effects of a hydrogel mask on skin hydration, tone, and aging. That can reduce in aging symptoms, and an increase in skin moisturization.

2. Conclusion

In conclusion, the hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer tends to provide better brightening, moisturizing, and anti-aging effects than a standard hydrogel mask containing L-Ascorbic acid, although the difference is not

statistically significant. There was no irritation, allergy and erythema occurred after patch testing and during experiment. The hydrogel mask containing L-Ascorbic acid entrapped in Sacran Polymer should be recommended for further use in daily mask routine to provide brightening, moisturizing, and anti-aging of the skin.

3. Suggestion

1) Comparison between indoor volunteers and outdoor votunteers.

2) The hydrogel mask should be used every day.

3) Increasing the percentage of L-Ascorbic acid.

4) The lifestyle of the volunteers should be controlled to obtain more accurate results.

References

Ammala, A. (2013). Biodegradable polymers as encapsulation materials for cosmetics and personal care markets. *International Journal of Cosmetic Science*, *35*(2), 113-124.

Baptista, S., Baptista, F., & Freitas, F. (2023). Development of emulsions containing L-ascorbic acid and α-tocopherol based on the polysaccharide FucoPol: Stability evaluation and rheological and texture assessment. *Cosmetics*, *10*(2), 56.

Bonté, F. (2011). Mécanismes d'hydratation de la peau: Nouvelles données. *Ann. Pharm. Fr*, *69*, 135-141.

C.K. Scientific. (n.d.). *MPA-CTplus New* [Software]. Medisa. Retrieved August 19, 2024, from https://medisa.com.au/skin-hair-analysis-products/c-k-scientific products/software/software-mpa-ctplus-new/

Davis, E. C., & Callender, V. D. (2010). Postinflammatory hyperpigmentation: A review of the epidemiology, clinical features, and treatment options in skin of color. *The Journal of Clinical and Aesthetic Dermatology*, *3*(7), 20.

Doi, M., Sagawa, Y., Momose, S., Tanaka, T., Mizutani, T., Okano, Y., . . . Masaki, H. (2017). Topical treatment with sacran, a sulfated polysaccharide from Aphanothece sacrum, improves corneocyte-derived parameters. *Journal of Dermatology*, *44*(12), 1360–1367.

Idalgo Vasques, L., & Ricci Leonardi, G. (2023). User experience in cosmetics: Perception analysis regarding the use of an anti-aging moisturizer. *Cosmetics*, *10*(1).

Kausar, R., & Akhtar, N. (2017). Formulation of an emulgel containing strawberry fruit extract and in-vivo evaluation for different skin parameter. *Indian Journal of Pharmaceutical Education and Research, 51*, 679-683.

Kiviluoma, L. (2013). *Vital face: Facial exercises and massage for health and beauty.* Singing Dragon.

Kwon, H. J. (2020). Evaluation of skin improvement effect and feeling of use by a hydrogel face mask pack. *Journal of the Korean Applied Science and Technology*, *37*(6), 1773-1778.

Markiewicz, E., & Idowu, O. C. (2020). Melanogenic difference consideration in ethnic skin type: A balance approach between skin brightening applications and beneficial sun exposure. *Clinical, Cosmetic and Investigational Dermatology,* 215-232.

Markiewicz-Tomczyk, A., Budzisz, E., & Erkiert-Polguj, A. (2022). Clinical evaluation of anti-aging effects of combined therapy—Azelaic acid, phytic acid, and vitamin C applied layer by layer in females with Fitzpatrick skin types II and III. *Journal of Cosmetic Dermatology*, *21*(12), 6830-6839.

MedChemExpress. (n.d.). *L-Ascorbic acid sodium*. MedChemExpress. Retrieved August 19, 2024, from https://www.medchemexpress.com/L-Ascorbic-acid-sodium.html

Nilforoushzadeh, M. A., Amirkhani, M. A., Zarrintaj, P., Salehi Moghaddam, A., Mehrabi, T., Alavi, S., . . . Mollapour Sisakht, M. (2018). Skin care and rejuvenation by cosmeceutical facial mask. *Journal of Cosmetic Dermatology, 17*(5), 693–702.

Okajima, M., & Kaneko, T. (2016). *SACRAN™ Blue Green Algal Polysaccharide*. https://www.dic-global.com/en/products/sacran/

Okan, G., & Rendon, M. I. (2011) The effects of a high glycerin content hydrogel premolded mask dressing on post-laser resurfacing wounds. *Journal of Cosmetic and Laser Therapy, 13,* 162-165.

Piérard, G. E., Piérard-Franchimont, C., & Piérard, S. (2013). Visioscan-driven ulev method. In E. Berardesca, H. I. Maibach & K.-P. Wilhelm (Eds.), *Non Invasive Diagnostic Techniques in Clinical Dermatology* (pp. 27-33). Springer, Berlin Heidelberg.

Pinterest. (n.d.). *Title of the Pinterest board or description of the pin*. Pinterest. Retrieved August 19, 2024, from https://www.pinterest.com/pin/15270086235246389/

Puluhulawa, L. E., Joni, I. M., Mohammed, A. F. A., Arima, H., & Wathoni, N. (2021). The use of megamolecular polysaccharide Sacran in food and biomedical applications. *Molecules, 26*(11).

Quattrone, A., Czajka, A., & Sibilla, S. (2017). Thermosensitive hydrogel mask significantly improves skin moisture and skin tone; Bilateral clinical trial. *Cosmetics*, *4*(2).

Ravetti, S., Clemente, C., Brignone, S., Hergert, L., Allemandi, D., & Palma, S. (2019). Ascorbic acid in skin health. *Cosmetics*, *6*(4), 58.

Sasano, H., Kato, K., Takeuchi, Y., Namiki, N., & Taniguchi, K. (2011). Sacran, a novel polysaccharide, prevents skin inflammation. *Journal of Dermatological Science, 64*(1), 13-21.

Satoshi, F., Keiichi, M., Yuki, T., Taishi, H., Yoichi, I., Yuki, K., . . . Hidetoshi, A. (2016). Clinical evaluation of novel natural polysaccharides sacran as a skincare material for atopic dermatitis patients. *Journal of Cosmetic, Dermatological Sciences and Applications, 6*, 9-18.

Sjerobabski-Masnec, I., & Situm, M. (2010). Skin aging. *Acta Clin Croat*, *49*(4), 515-518.

Sumaiyah, A., & Leisyah, B. M. (2019). The effect of antioxidant of grapeseed oil as skin anti-aging in nanoemulsion and emulsion preparations. *Rasayan J Chem, 12*, 1185–1194.

Surini, S., & Auliyya, A. (2017). Formulation of an anti-wrinkle hydrogel face mask containing ethanol extract of noni fruit (Morinda citrifolia L) for use as a nutracosmeceutical product. *International Journal of Applied Pharmaceutics*, *9*, 74–76.

Treesirichod, A., Chansakulporn, S., & Wattanapan, P. (2014). Correlation between skin color evaluation by skin color scale chart and narrowband reflectance spectrophotometer. *Indian Journal of Dermatology*, *59*(4), 339–342.

Westermann, T. V. A., Viana, V. R., Berto Junior, C., Detoni da Silva, C. B., Carvalho, E. L. S., & Pupe, C. G. (2020). Measurement of skin hydration with a portable device (SkinUp® Beauty Device) and comparison with the Corneometer®. *Skin Research and Technology*, *26*(4), 571–576.

Zerbinati, N., Sommatis, S., Maccario, C., Di Francesco, S., Capillo, M. C., Rauso, R., . . . Mocchi, R. (2021). The anti-ageing and whitening potential of a cosmetic serum containing 3-o-ethyl-l-ascorbic acid. *Life*, *11*(5).