

# TOCOTRIENOL-BASED FACIAL MASKS

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**W**ater-cast gels are used as facial masks with the potentials to adhere to the keratinous surface, hydrate and deliver the enriched supplements across the skin epidermis. The term hydrogel describes three-dimensional network structures obtained from a class of synthetic and/or natural polymers which can absorb and retain significant amount of water. The hydrogel structure is created by the hydrophilic groups or domains present in a polymeric network upon hydration in an aqueous environment (Rosiak and Yoshii, 1999).

Interestingly, the skin is the largest organ of the human body and the logical target for supplement delivery. Gels have potential as supplement delivery systems because of their ease of administration and hydration on contact with keratinocytes surfaces on the skin that allow diffusion out of the gel. However, gels are limited by low supplement loading capacity because of their thin nature and not all gel forming polymers are bioadhesive.

Vitamin E, a naturally occurring antioxidant is an essential lipid soluble vitamin which describes bioactivities of both tocopherol and tocotrienol derivatives. While tocopherols are generally present in nuts and common vegetable oils, tocotrienols are mainly concentrated in palm oil (Cottrell, 1991). Tocotrienol-rich fraction can be used on human skin as it did not induce any irritant contact dermatitis on human skin (Zafarizal *et al.*, 2008). The benefits of topically applied tocotrienol-rich fractions of palm vitamin E in protection of murine skin from oxidative damage induced by UV-irradiation have been reported (Weber *et al.*, 1997).

In MPOB, research work on bioadhesive gels incorporating palm tocotrienol-rich vitamin E was conducted. When applied to the skin, these gels infused the skin with moisture, retained them and enabled transdermal delivery of tocotrienols-rich vitamin E to keep the skin healthy.

## METHODOLOGY

Gels were prepared and loaded with tocotrienol-rich vitamin E from palm oil and PEG-40 hydrogenated castor oil. The resultant translucent mask is as shown in *Figure 1*. The characteristics of an ideal gel sheet were evaluated based on transparency, homogeneity, absence of air bubbles, plasticity and uniform thickness. The gel's strength and flexibility were tested by a texture analyser model Ta.xt.plus by Stable Micro Systems.



*Figure 1. Opaque commercial gel mask (left) and translucent palm tocotrienol-rich vitamin E gel mask (right).*

The formulated gels were first screened with *in vitro* irritancy assay kit for determination of their irritancy potentials by Human Irritancy Equivalent (HIE) score before conducting the *in vivo* patch test on 20 human volunteers. After 30 min of application (T1), the first strip is removed and the immediate irritative power (IIP) is evaluated. After 48 hr of application (T2), another strip is removed and the irritative power (IP) is evaluated and after 96 hr (T3), allergenicity potential (AP) is evaluated.

An efficacy study on acute moisturising test was also carried out on 20 human volunteers. Measurements were performed under standardised conditions with initial basal data collected after ac-



climatisation for 30 min. Three types of gel masks (tocotrienol-rich, placebo, commercial) were patched on volar forearms area and compared with untreated area (anatomically equivalent) on the same forearm. After 30 min of gel application, the gel was removed and the hydration levels were recorded at 5, 30, 60, 90, 120 and 180 min of resting.

The *in vitro* skin permeation assay was performed by placing the gel sheet and its residual fluid on polysulfone membrane with 0.45  $\mu\text{m}$  diameter pores in a jacketed chamber with phosphate buffer solution maintained at 37°C. The diffused vitamin E in the permeate was detected by UV-VIS and tested for antioxidant activity by 2,2,-diphenyl-1-picryl hydrazyl (DPPH)-scavenging activity.

## RESULTS AND DISCUSSION

Figure 2 shows the strength recorded before the gel was deformed for different formulation blends encompassing three types of gums. The highest bursting force recorded for gel formulated with optimised blends was 576.24 N and it was comparable with commercial sample gel.

which were compared with the untreated area. Gel mask with tocotrienol-rich vitamin E performed slightly better in increasing skin hydration level than commercial gel mask. Table 2 shows the Tukey test results between the hydration obtained from the skin treated with the respective samples against untreated areas at 180 min after gel removal. The results showed that there were significant differences in skin hydration level treated with tocotrienol-rich vitamin E gel mask and commercial gel mask versus untreated areas. The results for skin hydration level treated with placebo was not significant. These findings showed that gel mask without inclusion of actives (tocotrienol-rich vitamin E) performed poorly in maintaining skin hydration level.

The permeate fluids collected from the *in vitro* permeation study using Franz diffusion cells were found to contain tocotrienol-rich vitamin E and have antioxidant activity from DPPH-scavenging test (Figure 4).

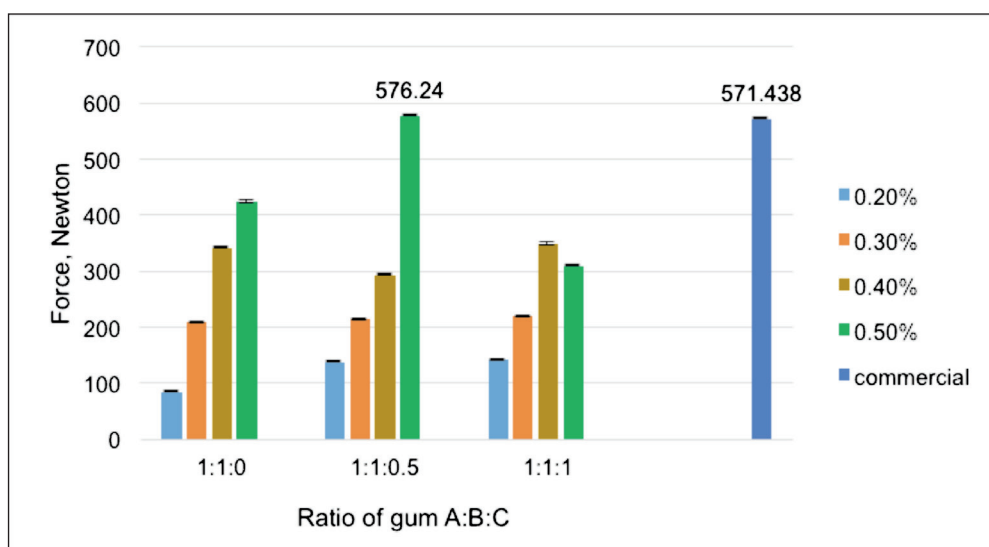


Figure 2. The force needed to initiate gel burst for various ratio of different gums and concentrations.

The irritancy results by *in vitro* and *in vivo* methods showed that the gels were non-irritant. The *in vivo* patch test result indicated that there were no irritative or allergic reactions that would be related to the presence or activity of common allergens. No skin reactions were observed for all the 20 subjects after 30 min (T1), 48 hr (T2) and 96 hr (T3) of patch removal (Table 1).

Figure 3 illustrates the percentage increased in skin moisture treated with tocotrienol-rich vitamin E, placebo, and commercial gel masks respectively,

## ECONOMIC ANALYSIS

Capital expenditure (CAPEX): RM 261 000 for vacuum emulsification machine, moulds, vacuum packing machine, computer with software programs and a van.

Payback period: four years.

Return on investment (ROI): 35%.

**TABLE 1. RESULTS OF *in vivo* PATCH TESTS ON 20 HUMAN VOLUNTEERS FOR FORMULATED GELS CONTAINING TOCOTRIENOL-RICH VITAMIN E**

Observed reaction	(IIP) T <sub>1</sub> (30 min)	(IP) T <sub>2</sub> (48 hr)	(AP) T <sub>3</sub> (96 hr)
-	20	18	20
+ -	0	2	0
+	0	0	0
++	0	0	0
+++	0	0	0
++++	0	0	0
No. of skin reaction	T1 = 0	T2 = 0	T3 = 0
(IIP) Total irritation reactions (*): 0			
Percentage irritation reactions: (0/20 subjects) = 0% (No reaction)			
(IP) Total irritation reactions (*): 0			
Percentage irritation reactions: (0/20 subjects) = 0% (No reaction)			
(AP) Total allergic reactions (**): 0			
Percentage allergic reactions: (0/20 subjects) = 0% (No reaction)			

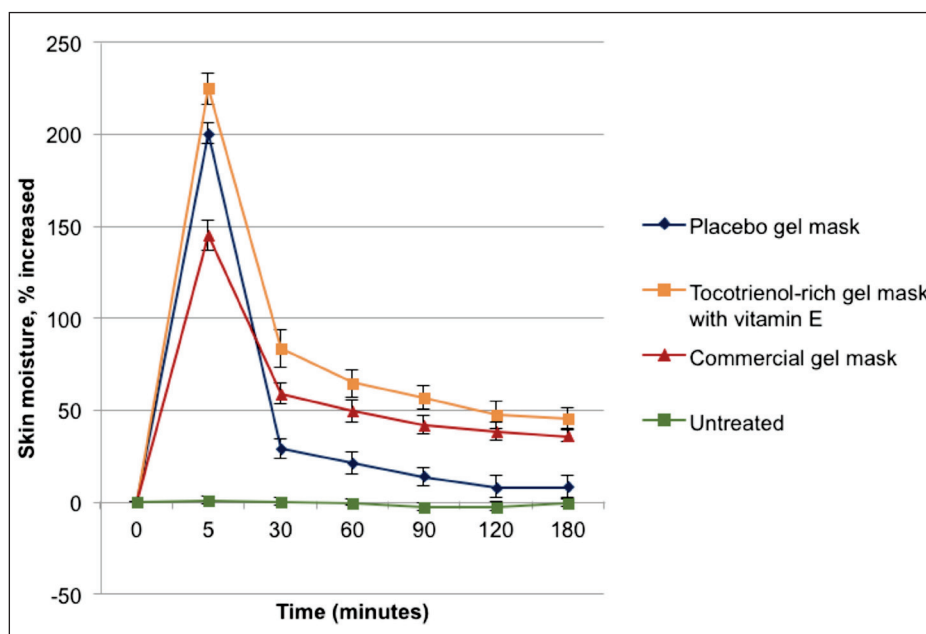


Figure 3. The percentage increase in moisture of skin treated with tocotrienol-rich, placebo and commercial gel masks respectively.

**TABLE 2. EFFECTS ON SKIN HYDRATION BY FORMULATED GEL MASK, PLACEBO AND A COMMERCIAL GEL MASK AT 180 MIN AFTER GEL REMOVAL**

Dependent variable: hydration						
(I) Sample	(J) Sample	Mean difference (I-J)	Std. error	Sig.	Tukey 95% confidence interval	
					Lower bound	Upper bound
	Placebo gel mask	-17.6417	7.15754	0.107	-38.2708	2.9874
Untreated	Gel mask with vitamin E	-30.7139*	7.15754	0.003	-51.3430	-10.0848
	Commercial gel mask	-21.5500*	7.15754	0.039	-42.1791	-0.9209

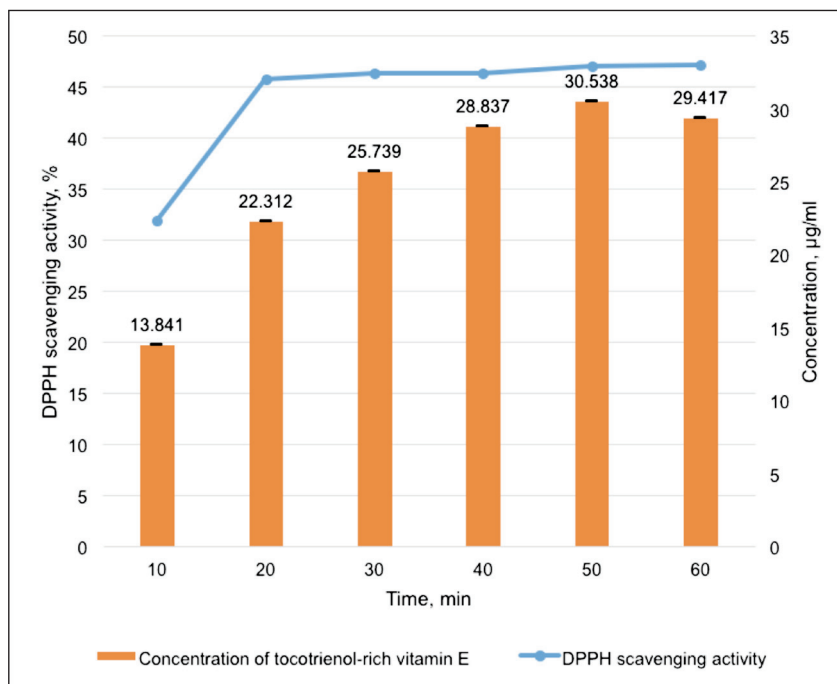


Figure 4. The concentration of tocotrienol-rich vitamin E diffused with DPPH scavenging activity vs. time.

## CONCLUSION

The formulated gel is found to be non-irritant for human skin. The application of hydrogel as facial masks supplemented with tocotrienol-rich vitamin E helps in maintaining the skin moisture levels and enriching the skin with antioxidants.

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