



Assessment of Color Match of Universal Tinted Sunscreens in Fitzpatrick Skin Phototypes I-VI

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Introduction

- Visible light and long wavelength ultraviolet A1 (VL+UVA1) have displayed ability to cause photodamage and hyperpigmentation, particularly in darker skin types¹.
- The majority of currently available organic sunscreens fail to provide adequate protection against these specific wavelengths².
- Tinted mineral sunscreens offer some protection; however, have associated challenges of color match impacting compliance

Objective

- To evaluate seven brands of universal tinted sunscreens, encompassing a spectrum of price ranges, and investigate color match.

Methods

- This study tested 7 brands of universal tinted sunscreens at various price points on 30 subjects, five participants for each human skin phototype (SPT) group
- Sunscreens were applied to participants’ arms at a concentration of 1 and 2mg/cm²
- Colorimetry, in addition to subject and investigator surveys were utilized to determine color match
- For subgroup analysis, SPTs were split into three groups due to similar data: SPT I-II, SPT III-IV, and SPT V-VI.
- When analyzing colorimetric data, change in L* (delta L*) was utilized to determine an appropriate color match. L* is a measure of the black-white axis and has a range from 0 to 100, with 0 being completely black and 100 being pure white.
- A positive delta L* would imply that the site with sunscreen application was lighter, relative to adjacent normal skin. A negative delta L* would suggest that the site with sunscreen application was darker relative to adjacent normal skin
- A delta L* value of +/- 1.10 is suggestive of a good color match to an individual’s normal skin, based off data analysis
- For subject and investigator surveys, a value greater than or equal to 70% was considered a satisfactory match.

Table 1. Sunscreens Tested

Product Identification	Mineral Universal Tinted Sunscreen	Cost per fl. oz.	SPF
A.	Sun Bum Mineral SPF 30 Tinted Sunscreen Face Lotion	\$12.05 per fl. oz.	30
B.	Bare Republic Mineral SPF 30 Tinted Face Sunscreen Lotion	\$11.17 per fl. oz.	30
C.	CeraVe Hydrating Mineral Sunscreen SPF 30 Face Sheer Tint	\$9.99 per fl. oz.	30
D.	Tizo Ultra Zinc Body and Face Mineral Sunscreen SPF 40-Tinted	\$12.86 per fl. oz.	40
E.	Eucerin Sensitive Tinted Mineral Face Sunscreen	\$8.23 per fl. oz.	35
F.	EltaMD UV Elements Tinted Facial Sunscreen	\$19.00 per fl. oz.	44
G.	La Roche-Posay Anthelios Mineral Tinted Sunscreen for Face	\$22.94 per fl. oz.	50

Table 1: Breakdown of the seven products tested as well as their cost per fluid ounce and SPF rating

Results: Figure 1. Colorimeter Data

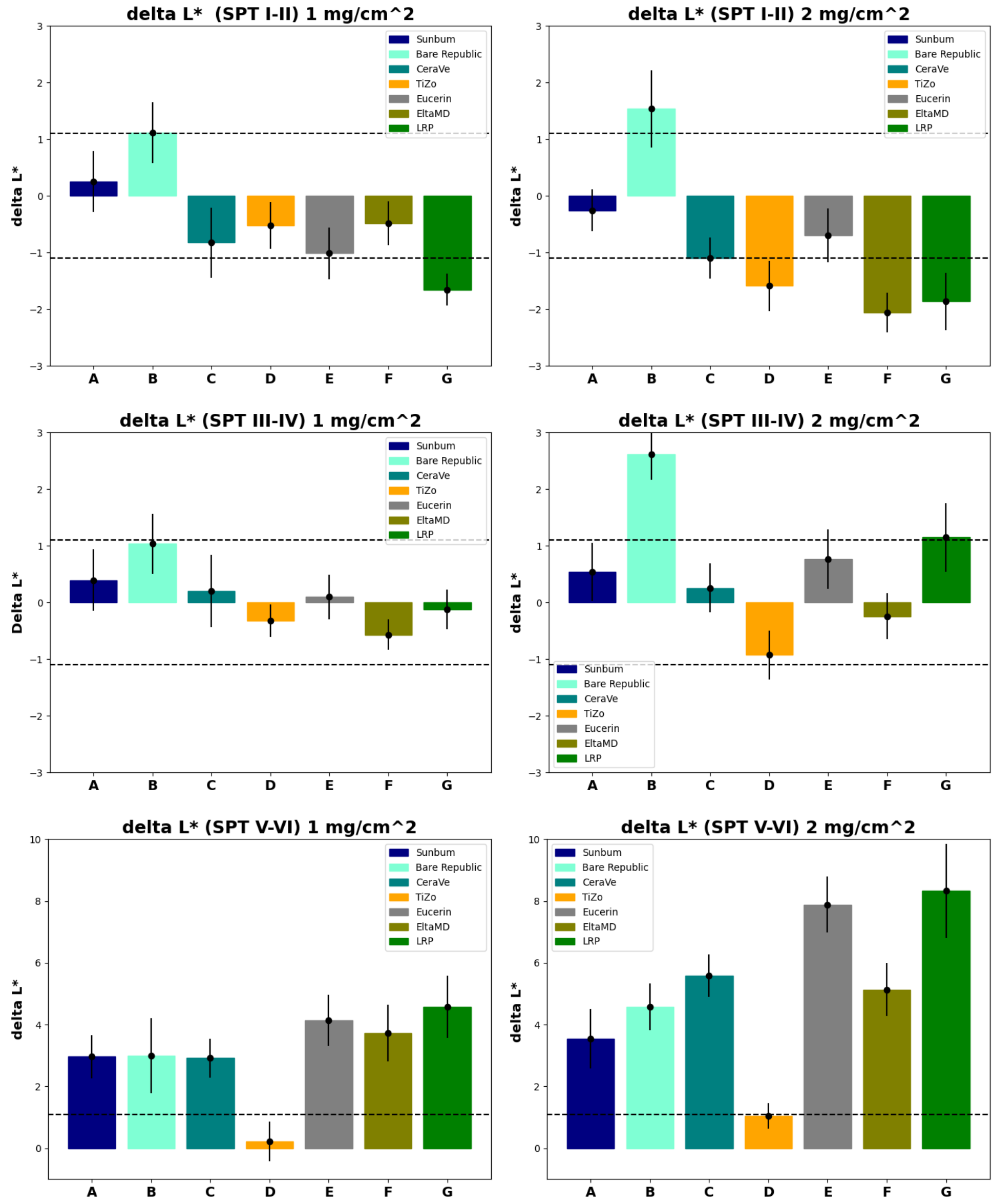


Figure 1: Colorimetric analysis for each of the three subgroups (SPT I-II, III-IV, and V-VI) at both 1 mg/cm² and 2 mg/cm² for all seven of the sunscreens tested.

Figure 2. Photography Examples of Subject Color Match

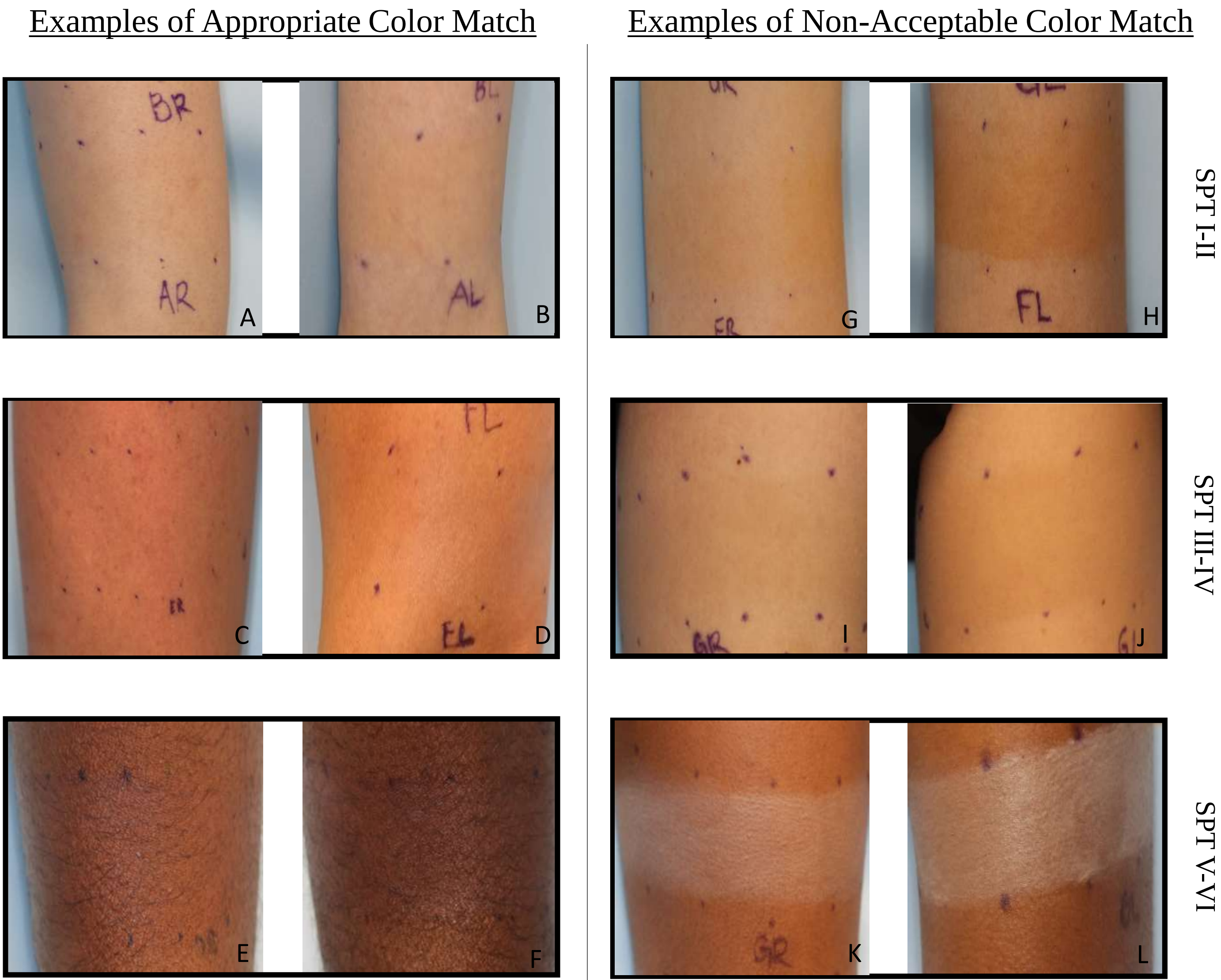


Figure 2: Representative photos of appropriate color match for representative group SPT I-II for product A at 1 mg/cm² (A) and 2 mg/cm² (B), SPT III-IV for product E at 1 mg/cm² (C) and 2 mg/cm² (D), and SPT V-VI for product D at 1 mg/cm² (E) and 2 mg/cm² (F). Also, photos of non-acceptable color match for representative group SPT I-II for product F at 1 mg/cm² (G) and 2 mg/cm² (H), SPT III-IV for product G at 1 mg/cm² (I) and 2 mg/cm² (J), and SPT V-VI for product G at 1 mg/cm² (K) and 2 mg/cm² (L).

Results

SPT I-II

- At 1 mg/cm², 2/7 products (A and D) achieved a satisfaction rate of 70% or higher in subject surveys, and 3/7 (A, B, and D) in investigator surveys. Colorimeter data indicated 6/7 (all but G) were appropriate color match.
- At 2 mg/cm², none of the products received a satisfaction rate of 70% or higher in subject surveys, with and only 1/7 (D) doing so in investigator surveys. Colorimeter data indicated 2/7 (A and E) were appropriate color match.

SPT III-IV

- At 1 mg/cm², 3/7 products (D – F) achieved a satisfaction rate of 70% or higher in subject surveys and 4/7 products (C – F) in investigator surveys. Colorimeter data indicated all products had appropriate color match.
- At 2 mg/cm², only 1/7 products (D) received 70% or higher satisfaction rating from the subject surveys, and 2/7 products (D and F) from the investigator surveys. Colorimeter data indicated 5/7 (all but B and G) had appropriate color match.

SPT V-VI

- At 1 mg/cm², 1/7 products (D) achieved a satisfaction rate of 70% or higher in subject surveys and 1/7 products (D) in investigator surveys. Colorimeter data also indicated 1/7 (D) had appropriate color match.
- At 2 mg/cm², 1/7 products (D) achieved a satisfaction rate of 70% or higher in subject surveys and 1/7 products (D) in investigator surveys. Colorimeter data also indicated 1/7 (D) had appropriate color match.

Discussion and Conclusions

- Results demonstrate that majority of universal tinted sunscreens had a good color match for the SPT III-IV group; however, these resulted in a dark and light cast on the skin for individuals with SPT I-II and SPT V-VI respectively, rendering them unsuitable for achieving an effective color match for these groups.
- Discrepancies between survey satisfaction and colorimeter data shows that consumers consider factors outside of solely color match, such as ease of application, absence of glare, transparent finish, no white spots, fast absorption, hydrating properties, soft texture, non-sticky or greasy sensation^{3,4,5}.
- This raises concerns about consumers potentially applying insufficient product to achieve an optimal color match, which could compromise the sunscreen’s photoprotective effects.
- An enhanced color match is likely to result in improved compliance and better photoprotection.
- The insights gained from this study will provide valuable recommendations for an appropriate color match for diverse sunscreen users
- While this study sheds light on color match for tinted sunscreens, further research is warranted, particularly on the efficacy of the sunscreens.
- Limitations of the study included only testing a limited selection of universal tinted sunscreens within a pre-selected price range

References

- Lyons AB, Trullas C, Kohli I, Hamzavi IH, Lim HW. Photoprotection beyond ultraviolet radiation: A review of tinted sunscreens. J Am Acad Dermatol. 2021;84(5):1393-1397. doi:10.1016/j.jaad.2020.04.079
- Torres AE, Awosika O, Maghfour J, Taylor S, Lim HW. Practical guide to tinted sunscreens. J Am Acad Dermatol. 2022;87(3):656-657. doi:10.1016/j.jaad.2021.12.040
- Reis-Mansur MCPP, da Luz BG, dos Santos EP. Consumer Behavior, Skin Phototype, Sunscreens, and Tools for Photoprotection: A Review. Cosmetics. 2023;10(2):39.
- Letellier S, Boyer F, Bacqueville D, Duplan H, Perrin L, Lapalud P. How to ensure consumers will be satisfied with a new sustainable sun care product developed for extreme environmental conditions. Food Quality and Preference. 2022;102:104661.
- Mellou F, Varvaresou A, Papageorgiou S. Renewable sources: applications in personal care formulations. Int J Cosmet Sci. 2019;41(6):517-25