Evaluation and comparison of in-vivo carotenoid measurement techniques: Skin resonance Raman spectroscopy and macular pigment optical density

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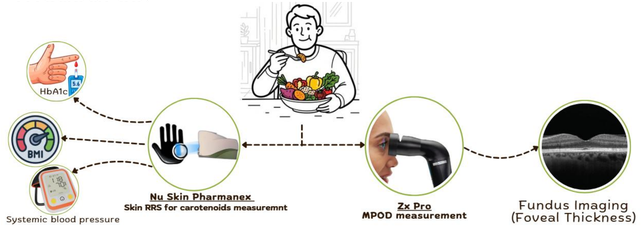
Introduction

- Carotenoids are naturally occurring pigments which primarily provides photoprotection against the short-wavelength by absorbing it and have added anti-inflammatory, anti-oxidant, and immunity boosting properties.
- Central retina and superficial skin layers accumulates these carotenoids components after its dietary consumption from fruits and vegetables or supplementation formulas.
- Measuring these carotenoids amount in the macula and skin using non-invasive optical methods helps knowing dietary intake status of an individual, its resultant localized accumulation as antioxidant status at the tissue level and estimate of long-term tissue level protection.

Purpose

This study was designed to investigate,

1) Repeatability of skin carotenoid measurements
2) Compare the skin carotenoid measurements with macular pigment optical density (MPOD). and
3) Evaluate the physiological association between skin carotenoids levels and other biological measures.



Materials and Methods

- The skin carotenoid scores (SCS) were measured three times with using the S3 Pharmanex Scanner (NuSkin, Utah, United States) which uses principals of Raman Spectroscopy and MPOD was measured using the Zx Pro (ZeaVision LLC, Chesterfield, Missouri, US).
- The various biological measures included HbA1c measurements, systemic blood pressure, body mass index and retinal evaluation with optical coherence tomography.

Results

- One hundred and fifty-six participants with a mean age of 49.0 ± 15.9 years were recruited. The mean MPOD and SCS were 0.44 ± 0.19 d.u. and - 32,708 ± 11,830.
- The association between the MPOD and SCS was extremely weak but statistically significant R^2 =6.0% (p=0.002).
- SCS was significantly associated with BMI (R^2 = 6.6%, p=0.003) and average systolic and diastolic blood pressure (R^2 =3.0% and 2.6%, p= 0.033 and 0.049 respectively). SCS was not significantly associated with age, HbA1c (p>0.05).
- MPOD showed a positive association with foveal thickness ($R^{2=}$ 3.5%, p= 0.02) but not with macular thickness.
- The repeatability of the SCS was assessed using intra class correlation coefficient and found to be excellent 0.96.

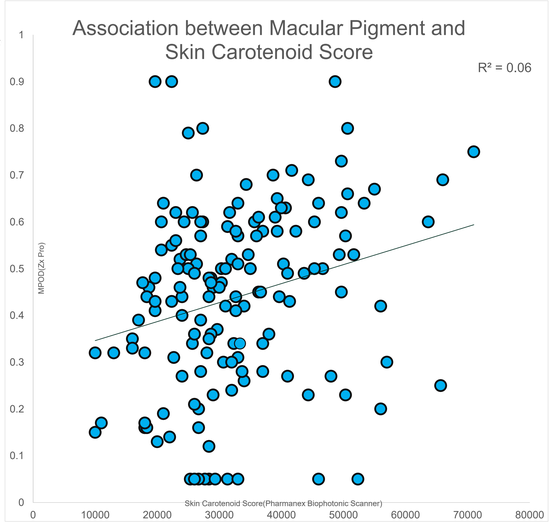


Table 1: Participant Characteristics

Assessed Variable (n=156)	Mean, (S.D.)	Range
Age (years)	48.99 (15.85)	18-81
Sex	60 male/ 96 Female	-
Systolic/Diastolic value in mm/Hg	119/75 (15.8/11.2)	-
HbA1C in %	5.9 (1.2)	4.3-14
BMI in kg/m2	27.95 (5.8)	17.2- 49.5
SCS measure 1 in Raman units	33,072 (11,819)	10,000 – 69,000
SCS measure 2 in Raman units	32,461 (11,965)	10,000- 72,000
SCS measure 3 in Raman units	32,592 (12,200)	10,000 – 72,000
SCS average in Raman units	32,708 (11,830)	10,000 – 71,000
MPOD in d.u.	0.44 (0.19)	0.05-0.90
Foveal thickness in µm	246 (21)	183-314
Foveal inner layer thickness (ILM to IPL) in µm	52 (8)	34-78
Macular thickness in µm	279 (13)	240-316

Conclusions

- The Pharmanex scanner has excellent reproducibility in measuring skin carotenoid scores.
- Further the skin carotenoid levels represent more systemic health as it is associated albeit weakly with BMI and systemic blood pressure. The skin carotenoid levels have extremely weak association with MPOD which is likely because the carotenoids in skin have very low levels of lutein and zeaxanthin.
- Thus, skin carotenoids cannot be used as a surrogate for carotenoid levels in eyes.

References

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