



## HYPERPIGMENTATION (MELASMA AND SOLAR LENTIGINES): A CROSS-SECTIONAL STUDY OF PHARMACY STUDENTS' KNOWLEDGE AND PERCEPTIONS OF NATURAL REMEDIES

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### ABSTRACT

Dark spots, including melasma and solar lentigines, affect people of different ages and are often treated with over-the-counter herbal or natural products. This study examined four herbal or natural remedies: apple cider vinegar, dandelion root extract, ricinoleic acid in castor oil, and vitamins C and E, and evaluated first year pharmacy students' knowledge and opinions of these remedies. Although these products are commonly marketed for skin lightening and dark spot reduction, scientific evidence supporting their use, especially for dandelion root extract, ricinoleic acid, and apple cider vinegar, remains limited. **Methods:** A survey with five knowledge based and five opinion-based questions was administered to 40 participants. **Results:** The sample was predominantly female (75%) and young, with 90% between 18 and 30 years of age. More than half of participants (55%) were from the DMV area before entering the Howard University College of Pharmacy program, and 65% had three or more years of paid work experience. The results from the knowledge-based questions showed a 64.5 percent correct answer rate, with most participants correctly identifying solar lentigo as another name for age spots and recognizing the potential role of vitamins C and E in reducing hyperpigmentation. Opinion based responses showed a skeptical attitude toward herbal remedies, with most participants disagreeing with claims about dandelion root extract, apple cider vinegar, and ricinoleic acid. **Conclusion:** These findings suggest that pharmacy students are generally cautious about natural remedies for dark spots, consistent with the

current evidence base and the need for continued education on evidence-based counseling for hyperpigmentation.

**KEYWORDS:** hyperpigmentation; melasma; solar lentigines; pharmacy students; herbal remedies; natural products.

## INTRODUCTION

Hyperpigmentation is a common skin condition that includes disorders such as melasma and solar lentigines. Because these conditions are often visible and cosmetically distressing, patients frequently seek over the counter or natural products designed to lighten dark spots. Although some botanical and antioxidant ingredients are promoted as safe, effective, and inexpensive alternatives, the quality of evidence supporting many of these products varies widely.

Pharmacists are often asked to counsel patients about these remedies, making it important for pharmacy students to understand both the clinical evidence and the safety concerns associated with common natural treatments.

Vitamin C has the strongest support among the products examined in this study, with evidence showing depigmenting and photoprotective effects in melasma and photoaging (Papageorgiou et al., 2023). Combination topical antioxidants such as vitamins C and E also show enhanced ultraviolet protection compared with either ingredient alone (Lin et al., 2003). In contrast, a systematic review found few clinical trials evaluating natural ingredients for hyperpigmentation, indicating that much of the available evidence remains limited (Hollinger et al., 2018).

Marketed remedies, such as dandelion extract, castor oil, and apple cider vinegar, have weaker support for treating dark spots. Dandelion extract has shown antioxidant effects in laboratory studies, but these findings have not been translated into strong human evidence for hyperpigmentation treatment (Yang & Li, 2015). Apple cider vinegar may also pose irritation and chemical burn risks when used improperly on the skin (Yang & Li, 2015). For these reasons, pharmacy students should be trained to distinguish between mechanistic promise and clinically meaningful efficacy.

A literature gap remains in pharmacy education research focused specifically on first-year pharmacy students' knowledge and opinions about natural remedies for hyperpigmentation,

melasma, and solar lentigines, despite prior studies on related dermatologic and herbal topics. For example, one publication surveyed pharmacy students on natural remedies for dark circles and puffy eyes (e.g., cucumber slices, chamomile tea bags, witch hazel, arnica) and found moderate knowledge levels similar to the present study, but did not examine hyperpigmentation conditions. Similarly, another publication assessed students' perceptions of herbal remedies for stretch marks (e.g., cocoa butter, shea butter, vitamin E, calendula oils) and reported cautious attitudes toward efficacy, yet hyperpigmentation-specific remedies like dandelion root, castor oil, or apple cider vinegar remain unstudied in this population. (Sun et al., 2024; Montague et al., 2024).

The purpose of this study was to assess first-year pharmacy students' knowledge and perceptions of selected herbal and natural therapies for dark spots. A secondary purpose was to determine whether demographic factors were associated with differences in knowledge or opinion. Understanding these patterns may help inform future instruction on complementary and alternative dermatologic therapies.

## METHODS AND MATERIALS

This cross-sectional study was performed as part of a standard Drug Informatics course at Howard University College of Pharmacy first-year pharmacy students. As part of the course, students received guidance on survey taking and research development. Participation in the survey was optional and done electronically. The questionnaire made up of three parts: (1) demographic variables, (2) five knowledge-based statements, and (3) five opinion-based statements. Gender, state of residence prior to enrollment in the HUCOP program, highest educational level before joining HUCOP program, and years of paid work experience (RX-related, non-RX healthcare related, or non-healthcare) were the demographic variables.

Knowledge-based questions were given in a true or false statements to evaluate the knowledge of specific herbal therapies for dark spots, such as apple cider vinegar, dandelion root extract, ricinoleic acid (castor oil), and the combination of Vitamin E and Vitamin C oil. Opinion-based questions were evaluated using a 2-point Likert scale (1 = Agree/Strongly Agree; 2 = Disagree/Strongly Disagree). Descriptive statistics were calculated for demographic and survey responses. Crosstabulation and Pearson chi-square analyses were generated using the latest SPSS system to examine the relationships between survey responses and demographic characteristics with a statistical significance set at  $p < 0.05$ . The students were provided the results.

## RESULTS AND DISCUSSION

The demographic characteristics presented in Table 1 show that the study population was largely female (75%), with males accounting for 25% of respondents. Most participants (90% were between the ages of 18 and 30), with 52.5% aged 18-24 and 37.5% aged 24-30. Only 10% of responses were older than 30 years. Prior to enrolling in the HUCOP program, 55% of participants lived in the DMV area (District of Columbia, Maryland, and Virginia), with 42.5% residing in other states. These findings show that the cohort was predominantly young, female, and regionally concentrated, which is typical of early professional pharmacy students.

**Table 1: Demographics Data (Gender, Age, Residence).**

Demographic characteristic	Breakdown of demographic characteristic	n (%)
Gender	Male	10 (25%)
	Female	30 (75%)
Age (years)	Age 18–24	21 (52.5%)
	Age 24–30	15 (37.5%)
	Age >30	4 (10%)
State you have lived before coming to Howard Pharmacy Program	DMV (DC/MD/VA)	22 (55%)
	Other States	17 (42.5%)

The findings in **Table 2** provide understanding on participants' previous work experience and educational achievement prior to enrolling in the HUCOP program. A significant majority of respondents (65%) claimed three or more years of paid work experience, with 40% having five or more years of employment history. In terms of employment type, 50% of participants had pharmacy-related (RX-related) work experience, whereas 22.5% reported non-pharmacy healthcare-related employment and 22.5% indicated non-healthcare work experiences. In terms of academic preparation, 65% of respondents had a bachelor's degree before enrolling, with 17.5% having a master's degree or above. A lower proportion stated pre-pharmacy (12.5%) or associate-level (5%) education. Overall, these findings indicate that the cohort came into the pharmacy program with significant prior professional and academic expertise.

**Table 2: Demographics Data (work experience and education).**

Survey Question	Survey Question	n (%)
How many years have you had a paying job before joining HUCOP program?	1-2 years	12 (30%)
	3-4 Years	10 (25%)
	5 or more years	16 (40%)
	Other	2 (5%)
What kind of work have you had?	Non-RX (Health-related)	20 (50%)
	Non-Healthcare	9 (22.5%)

	Other	2 (5%)
What is the highest education level you have before HUCOP program?	Pre-pharmacy	5 (12.5%)
	Associate	2 (5%)
	BSc/BA	26 (65%)
	Ma/MSc or higher	7 (17.5%)

The data in **Table 3** show participants' understanding of specific herbal therapies for dark spots. Overall, respondents demonstrated a modest level of awareness, with an average accurate response rate of 64.5% across all five knowledge-based questions. The identification of "solar lentigo" as another name for age spots had the most correct replies (72.5%), indicating a high level of familiarity with dermatologic terminology. Similarly, 70.0% correctly identified the possible advantage of combining Vitamin E and Vitamin C in reducing hyperpigmentation, demonstrating an awareness of antioxidant synergy.

Around 65.0% correctly identified the appropriate application recommendations for apple cider vinegar, while 60.0% recognized the claimed anti-lightening characteristics of ricinoleic acid. In contrast, only 55.0% properly responded to the statement about dandelion root extract, demonstrating a lesser level of confidence in assessing its preventive role in age spot formation.

Overall, the findings suggest that, while students have good baseline knowledge of many herbal and antioxidant-based claims, there are still gaps in understanding precise mechanisms and evidence-based support for various therapies.

**Table 3: Demographics Data (work experience and education).**

Question	Correct Answer	Participants with Correct Answers (n %)	True (n)	False (n)	Mean Correct Answers Ratio	SD	Variance
1. In the treatment of age spots, apple cider vinegar needs to be briefly patted on the skin ( $\leq 15$ seconds).	True	26 (65.0%)	26	14	0.650	0.483	0.233
2. Ricinoleic acid has anti-lightening properties as one of the ingredients of castor oil.	True	24 (60.0%)	24	16	0.600	0.496	0.246
3. Another name for age spots/liver spots is solar lentigo.	True	29 (72.5%)	29	11	0.725	0.452	0.204
4. Dandelion root extract is useful to prevent age spots from forming.	False	22 (55.0%)	18	22	0.550	0.504	0.254
5. Significant reduction in dark spots of melasma has been observed when Vitamin E is used in combination with Vitamin C.	True	28 (70.0%)	28	12	0.700	0.464	0.215
Average	—	64.5%	—	—	0.645	0.480	0.230

**Table 4** summarizes participants' assessments of the efficacy of chosen herbal therapies for dark spots. Overall, respondents were dubious about these treatments, with disagreement outweighing agreement on most items. For example, 65.0% disagreed or strongly disagreed that dandelion root extract can prevent the production of age spots, and 70.0% disagreed that apple cider vinegar is beneficial in preventing oxidative stress-related pigmentation.

Similarly, 72.5% disagreed with the stated dermatologic benefits of ricinoleic acid, while 75.0% rejected the myth that age spots are caused by insufficient sunlight exposure. Although a slightly higher proportion of respondents (45.0%) agreed that Vitamin E and Vitamin C could work together to diminish age spot coloring, disagreement remained the majority (55.0%). The overall mean Likert score of 1.68 demonstrates a general tendency toward disagreement, showing pharmacy students' cautious or evidence-based views on herbal dermatologic therapies.

These findings reveal a significant difference between moderate knowledge levels and considerably stronger skepticism in professional opinion, emphasizing the necessity of evidence-based education when discussing natural or herbal remedies in clinical counseling.

**Table 4: Results for Opinion-based Questions (n=40).**

Statements	Agree or Strongly Agree (n %)	Disagree or Strongly Disagree (n %)	Mean Likert Score (1-2)	SD
1. I believe that dandelion root extract can prevent the formation of age spots.	14 (35.0%)	26 (65.0%)	1.65	0.483
2. I think that apple cider vinegar can prevent age spots from growing by inhibiting oxidative stress.	12 (30.0%)	28 (70.0%)	1.70	0.464
3. I agree that ricinoleic acid not only promotes hair growth, but also hydrates and conditions the skin.	11 (27.5%)	29 (72.5%)	1.73	0.452
4. I believe that age spots are formed from the skin not receiving enough sunlight.	10 (25.0%)	30 (75.0%)	1.75	0.440
5. I agree that Vitamin E and Vitamin C work hand in hand in the reduction of age spot coloration.	18 (45.0%)	22 (55.0%)	1.55	0.504
Average			1.68	

## DISCUSSION

The present study evaluated pharmacy students' knowledge and perceptions of specific herbal and natural therapies for dark spots, such as solar lentigines and melasma, with the support of the dermatologic and complementary medicine literature. Evidence supporting

these treatments are heterogeneous and, frequently, limited. Antioxidant combinations such as vitamins C and E have demonstrated mechanistic and clinical support for photoprotective and depigmenting effects by reducing ultraviolet (UV)-induced oxidative stress, scavenging reactive oxygen species, and modulating melanogenesis pathways (Papageorgiou et al., 2023; Schagen et al., 2012). In difference, there is still little clinical evidence to support the use of ricinoleic acid-containing castor oil, dandelion root extract, and apple cider vinegar for hyperpigmentation.

The primary purpose of this research was to study natural and herbal therapies that are frequently sold to treat black spots, and the secondary purpose was assessing pharmacy students' understanding and opinions about these treatments. Apple cider vinegar is widely marketed for its exfoliating and "brightening" properties, which are primarily attributed to the acetic acid and minor polyphenolic content; however qualitative clinical data for hyperpigmentation are lacking, and case reports and professional opinions highlight the risks of irritation and post-inflammatory hyperpigmentation with certain concentrations of apple cider vinegar from natural home remedies (Feldstein et al., 2015).

Essentially dandelion (*Taraxacum*) extracts have shown antioxidant and photoprotective properties in vitro, such as protecting human skin fibroblasts from UVB-induced oxidative stress and premature aging, these outcomes have not been translated into human clinical trials showing depigmenting efficacy in solar lentigines or melasma (Yang & Li, 2015). The main fatty acid in castor oil, ricinoleic acid, is widely known for its emollient and barrier-supporting capabilities, but dermatologic data does not provide strong evidence for its direct melanogenesis-modulating or pigmentation-reducing activity in humans (Zhang et al, 2018). In contrast, vitamins C and E have shown some support in clinical studies, though long-term studies are still needed. Systematic reviews and clinical trial data have presented topical vitamin C and antioxidant combinations have demonstrated to improve melasma and photoaging when used as adjunctive therapies to photoprotection and other standard therapies (Papageorgiou et al., 2023, Lin et al., 2003).

The study cohort consisted primarily of young, female pharmacy students with prior work experience and healthcare-related backgrounds, which corresponds to the typical pharmacy student demographics observed in the research. The comparatively high proportion of participants with prior healthcare experience and higher educational attainment shows that the cohort entered the program academically knowledgeable and professionally centered.

Knowledge-based items showed sufficient knowledge of herbal claims, with an average response rate of 64.5%.

The present study's findings of moderate knowledge (64.5% correct rate) and skeptical opinions (mean Likert score 1.68 toward disagreement) on natural remedies for hyperpigmentation align closely with patterns in related pharmacy student surveys on herbal and dermatologic topics. A literature review surveyed first-year pharmacy students on remedies for dark circles and puffy eyes including cucumber slices, chamomile tea bags, witch hazel, and arnica. It reported similar moderate knowledge levels, with students showing familiarity with common terms but uncertainty about efficacy and safety, mirroring the lower correct rates here for dandelion root extract (55%) and ricinoleic acid (60%) (Sun et al., 2024). Another literature review found cautious perceptions of herbal remedies for stretch marks, cocoa butter, shea butter, vitamin E, and calendula oils, with most students questioning clinical benefits despite awareness of marketing claims, similarly to the majority disagreement (65-75%) on apple cider vinegar, dandelion, and ricinoleic acid in this study (Montague et al., 2024). Collectively, these comparisons justify continued pharmacy education on evidence-based counseling for natural dermatologic remedies, as students consistently demonstrate awareness of popular products but remain appropriately cautious without strong clinical data.

Years of work experience were shown to be the only significant demographic component connected with knowledge and opinion-based responses, suggesting that higher degrees of professional exposure may lead to more evidence-based beliefs. Experiential learning, involving real-world patient interviews and preceptor observation, may improve students' critical thinking of herbal and natural treatment claims. There were no significant relationships found for gender, age, educational level, or geographic origin, suggesting that professional experience may be more powerful than demographic characteristics in developing attitudes of alternative therapies.

Opinion-based findings indicate suspicion about the effectiveness of apple cider vinegar, dandelion root extract, and ricinoleic acid for dark spots. Even for vitamins C and E, agents with relatively greater mechanistic and clinical support, based on their usefulness did not reach a clear majority, demonstrating a careful approach to drawing conclusions from limited or additional evidence. (Papageorgiou et al., 2023, Hollinger et al., 2018)

The disparity between broad public usage of herbal skincare solutions and a lack of robust scientific proof emphasizes the significance of including complementary and alternative medicine within pharmacy school. Many plant-derived depigmenting products, such as dandelion and castor oil-based treatments, lack well-controlled clinical trials, with most supporting data coming from *in vitro* or small uncontrolled research (Zhang *et al*, 2018). As patients seek expert guidance on natural and over-the-counter remedies for hyperpigmentation, pharmacists must balance patient interest with safety and efficacy research (Schagen *et al.*, 2012). The findings suggest structured teaching on evaluating herbal and cosmeceutical claims, differentiating between mechanistic/preclinical and clinical evidence, and counseling strategies highlighting sun protection, evidence-based first-line therapies, and realistic expectations for adjunctive natural agents (McConaha and Lunny, 2014).

Some limitations should be observed. The sample size was fairly small ( $N = 40$ ) and confined to a single institution, which limited generalizability and external validity. The primarily youthful, female demographic profile further limits extrapolation to larger pharmacy student and practitioner populations. The use of self-reported survey data presents the possibility for recall and reporting bias. Some chi-square analyses may have been underpowered due to low anticipated cell counts. To increase pharmacy students' knowledge and confidence in herbal and natural dermatologic products, subsequent studies should involve larger multi-institutional samples with more diverse demographics and assess customized educational interventions.

Overall, this study found that pharmacy students have a sufficient degree of awareness but are cautious of herbal therapies for hyperpigmentation. Their caution looks generally coordinated with the present evidence base, in which antioxidant vitamins C and E have the highest, although still developing, support. Many other popular treatments remain understudied. These findings emphasize the importance of continuing education in critical evaluation of alternative medicines, along with counseling that emphasizes treatments with documented safety and efficacy while understanding patients' interest in natural products.

### **Conclusion**

Hyperpigmentation, including age spots and melasma, remains a common cosmetic concern for which many herbal and natural products are marketed despite limited supporting evidence. In this study, first-year pharmacy students showed moderate knowledge of selected

natural therapies, with stronger recognition of solar lentigo and the potential antioxidant role of vitamins C and E than of dandelion root extract, ricinoleic acid, or apple cider vinegar. However, their opinions were generally skeptical, reflecting a cautious approach to the effectiveness of herbal remedies for dark spots. This gap between moderate knowledge and negative perceptions suggests that students may recognize some basic concepts while still lacking confidence in the clinical value of many natural products. The chi-square results showed no significant association between gender and the knowledge or opinion items tested, indicating that responses were similar across gender groups in this sample.

### CONCLUSION:

Overall, these findings reinforce the need for stronger evidence-based education on complementary dermatologic therapies in pharmacy training. Students should be taught how to distinguish between preliminary laboratory findings and clinically proven benefits, especially when counseling patients who prefer natural treatments. Because many herbal remedies for hyperpigmentation have limited or inconsistent clinical support, future research should focus on well-designed studies that evaluate their safety, efficacy, and appropriate use. The small sample size and single-institution design also limit generalizability, so larger multi-institutional studies are needed to better understand pharmacy students' knowledge and perceptions across diverse settings.

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