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# THE APPLE MINT EFFECT

Dark circles and under-eye bags affect all ages, caused by pigment changes, blood vessel leakage, and lymphatic dysfunction. Genetics and internal or external stressors can worsen them. Effective treatment needs a multifactorial approach targeting circulation, lymphatic flow, and hyperpigmentation in the delicate eye area.

**D**ark circles under the eyes and puffy under-eye bags are widespread cosmetic concerns that extend beyond aesthetic dissatisfaction. These conditions often contribute to emotional stress and reduced self-esteem. Often interpreted as signs of fatigue, psychological stress, or premature aging, these features affect individuals of all ages, skin types, and genders, including adolescents<sup>1</sup>. The under-eye area is uniquely vulnerable due to its anatomical and physiological characteristics. The skin in this area is exceptionally thin and contains minimal subcutaneous fat. It is also densely populated with blood and lymphatic vessels<sup>2</sup>. These properties make the area particularly susceptible to intrinsic and extrinsic stressors. Intrinsic factors include genetic predisposition, ethnic background, hormonal fluctuations, and the natural aging process. Extrinsic influences, such as ultraviolet radiation, environmental pollutants, allergic reactions, mechanical

irritation from eye rubbing, sleep deprivation, and chronic stress, can further exacerbate the condition.

## MULTIFACTORIAL CAUSES OF DARK CIRCLES AND UNDER-EYE BAGS

The pathogenesis of dark circles is multifactorial. One major contributor is pigmentary alteration, specifically the overproduction and deposition of melanin. This process is often intensified by post-inflammatory hyperpigmentation, particularly in individuals with darker skin tones. Another significant factor is the cutaneous vascular network. Increased blood capillary permeability and the resulting impaired microcirculation in the under-eye area allow red blood cells to leak into the surrounding tissue. This leads to bluish or purplish discoloration, which becomes more pronounced with age, as the dermis thins and the



subdermal vasculature becomes more visible. In contrast, under-eye bags are primarily associated with structural and fluid dynamic changes. As we age, the connective tissue weakens, allowing orbital fat to shift forward, creating a puffy appearance. At the same time, the lymphatic system, which plays a crucial role in maintaining interstitial fluid balance and immune surveillance, may become less efficient. Lymphatic capillaries are highly permeable and responsible for absorbing excess fluid, macromolecules, and immune cells. When lymphatic drainage is compromised due to aging, inflammation, or other factors, fluid accumulates in the under-eye tissue, leading to edema and the characteristic swelling of undereye bags.

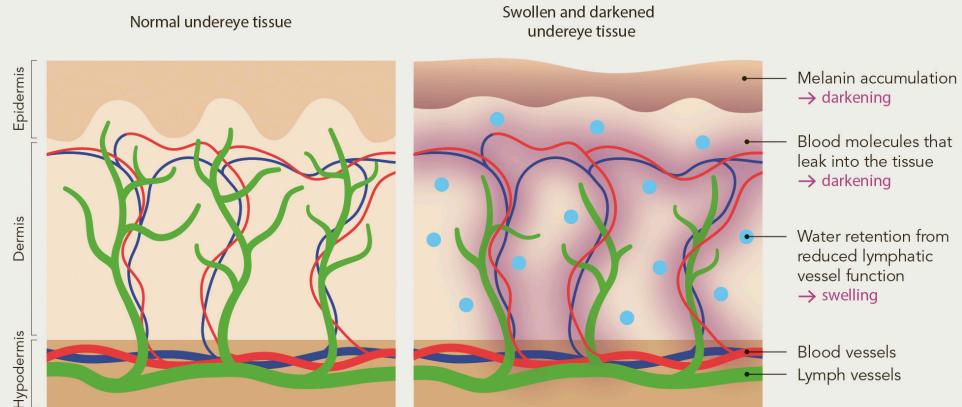
## TARGETING THE CUTANEOUS VASCULAR NETWORK TO IMPROVE UNDER-EYE APPEARANCE

Therefore, the cutaneous vascular system, which consists of both blood and lymphatic vessels, is essential for maintaining skin homeostasis in the under-eye region. Disruption in either network can significantly impact on the appearance and functionality of this area. Capillary blood leakage and reduced microcirculation can lead to pigment deposition and tissue stress, while impaired lymphatic flow results in fluid retention and swelling. Understanding the interplay between vascular integrity and lymphatic function in the under-eye area is critical for developing effective active ingredients for this delicate skin region. Strength-

ening capillary walls and enhancing lymphatic drainage are promising strategies to reduce the appearance of both dark circles and under-eye bags (Figure 1).

## APPLE MINT EXTRACT AS A MULTIFUNCTIONAL INGREDIENT FOR UNDER-EYE CARE

Mentha suaveolens, commonly known as apple mint, is a perennial herb that is native to southern Europe, North Africa, and parts of temperate Asia. Apple mint is characterized by its hairy leaves, as well as stems and is distinct from other mint species because it lacks menthol and has a mild, green apple-like flavor. Apple mint has long been used in cooking and is recognized for its antimicrobial, anti-inflammatory, and antioxidant properties, primarily due to its high polyphenol and terpenoid content. A clinical study reported that apple mint extract had a brightening effect on the skin when consumed orally<sup>3</sup>. This study, coupled with the known high polyphenol content of apple mint, has initiated further research into the potential benefits of apple mint for the under-eye region. In vitro studies suggest that apple mint extract may enhance skin barrier integrity, improve epidermal hydration, and inhibit melanin synthesis. Apple mint extract has also demonstrated the ability to prevent inflammation-induced vascular hyperpermeability in venous endothelial cells and positively influence lymphatic endothelial cells. This indicates its potential relevance in dark eye circles and puffiness.

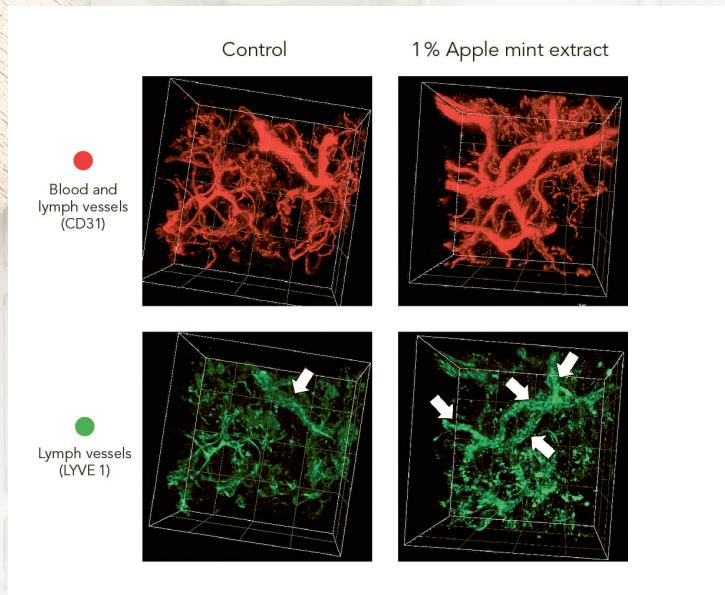


**FIGURE 1**

**Underlying causes of under-eye puffiness and discoloration**

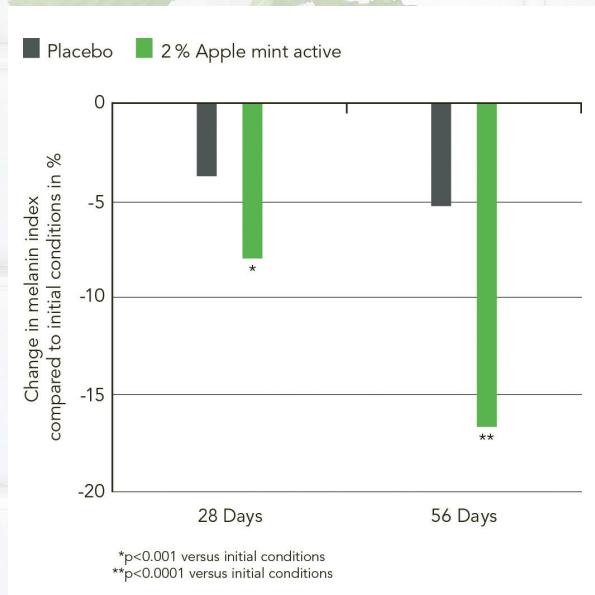
## FIGURE 2

Effect of apple mint extract on the vascular network in vascularized subcutaneous adipose tissue



## FIGURE 3

Effect of apple mint active on melanin index over time compared to placebo



## STRENGTHENING THE VASCULAR NETWORK

As apple mint affects lymphatic and venous endothelial cells, the effect was further investigated in a 3D ex vivo model based on human adipose tissue. The vascularized subcutaneous adipose tissue model was treated with apple mint extract for 14 days. Gene expression analysis revealed an upregulation of key endothelial markers. The lymphatic markers LYVE1 and PROX1 increased by 97% and 175%, respectively, indicating enhanced lymphatic activity. LYVE1 is involved in lymphatic capillary formation, while PROX1 regulates lymphatic endothelial cell identity. Additionally, CD34, a marker of vascular endothelial cells, was upregulated by 132%. These findings support the potential of apple mint extract to promote the functionality of the vascular network in human skin tissue. In addition, the lymphatic and vascular architecture was assessed using 3D imaging with the endothelial markers CD31 and LYVE1 (Figure 2). The overall vascular network, visualized by CD31 staining, remained stable following treatment with apple mint extract. However, the increased expression of CD34 suggests a strengthening of the blood vessel structure. Notably, 3D imaging revealed a more pronounced lymphatic network, as indicated by enhanced LYVE1 staining after treatment. In summary, these findings from the vascular-

ized adipose tissue model indicate that apple mint extract supports vascular stability and promotes lymphatic network expansion.

## BRIGHTENING OF DARK CIRCLES AND REDUCING PUFFINESS

In vitro and ex vivo efficacy studies have shown that apple mint extract has a beneficial effect on the vascular network, reduces melanin synthesis and supports the skin barrier, which plays an important role in the under-eye area. The effect of apple mint on improving the eye area was therefore investigated in a double-blind, placebo-controlled clinical study with 44 female volunteers, who were affected by either dark eye circles or bags under the eyes. The volunteers applied a cream with apple mint extract or a corresponding placebo to each side of the face, with the focus on the eye area for 56 days. The application of the apple mint extract led to a significant increase in luminance after 56 days, measured by the L\* value of the skin in the eye area. This observed improvement aligns with the reduction in pigmentation over time. The melanin index is significantly reduced by 8% after 28 days and by 16.6% after 56 days of apple mint treatment (Figure 3).

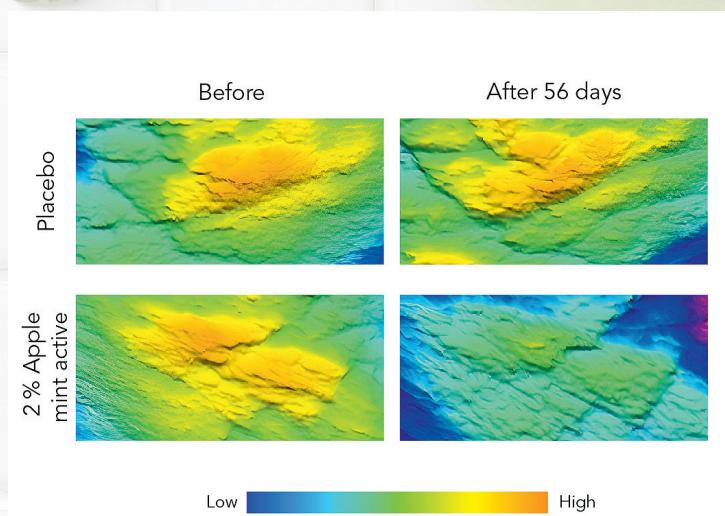
## FIGURE 4

Visible reduction in dark circles observed with apple mint active treatment compared to placebo



## FIGURE 5

Reduction in eye bags observed with apple mint active treatment compared to placebo



Impressively, 95% of all volunteers treated with apple mint have shown a decrease in the melanin index in the area of dark circles under the eyes. Furthermore, the blood circulation in the eye area is increased in a time-dependent manner. The blood flow was significantly improved by 13.4% after 28 days and by 20.6% after 56 days of apple mint application. These results correspond with the visible improvement of vascular and pigmented dark eye circles as observed in the volunteers' pictures (Figure 4).

In addition to the reduction of dark eye circles, the application of apple mint extract reduced the volume of eye bags. This reduction in eye bags is demonstrated in relief images (Figure 5).

The relief images visually highlight the decrease in eye bags, as evidenced by the shift from orange to green representing reduced volume in the undereye region.

## CONCLUSION

Dark circles and undereye bags are common cosmetic concerns with complex, multifactorial origins involving pigmentary changes, blood vessel dysfunction, and lymphatic impairment. The vulnerability of the undereye region makes it particularly profound to both intrinsic and extrinsic stress-

ors. Apple mint (*Mentha suaveolens*) extract has demonstrated promising effects in addressing these concerns. In vitro, ex vivo, and clinical studies show that it supports vascular and lymphatic function, reduces melanin synthesis, and improves skin brightness and microcirculation. Clinically, apple mint increased the brightness and reduced the puffiness in the undereye area, confirming its potential as an effective active ingredient for targeted undereye care.

### References:

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