# Quali-B Vitamin B3 (Niacinamide PC)

## ID Card

| Key Benefit | Scalp Care (strengthens scalp barrier / moisturization)  
Hair Thickening (helps increase hair diameter) |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>INCI Name</td>
<td>Niacinamide</td>
</tr>
<tr>
<td>Description</td>
<td>Niacinamide PC has a low guaranteed level of residual nicotinic acid to address any concerns about unpleasant scalp sensations</td>
</tr>
</tbody>
</table>
| Technical   | **Form:** powder  
**Use level:** Up to 1%  
**pH of use:** 4 to 8  
**Preservative:** Free  
**Solubility:** Water soluble  
**Target:** Hair fiber and Scalp  
**Biodegradability:** Readily biodegradable |
| Registration Certification | ![China] ![Korea] ![Vegan] ![Vita] |

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Quality for Life™ seal that guarantees the highest standards for Quality, Reliability, Traceability, and Sustainability.
Quali-B Vitamin B3 (Niacinamide PC)

Penetrates the hair and contributes to thicken & strength the fiber

Significantly increases fibre diameter*  
- 4% Virgin & Fine textured hair  
- 6% Bleached Hair & Coarse hair  

*Results based in the combination of Caffeine, Niacinamide, Panthenol, Dimethicone and Acrylate polymer (CNPDA)

White represents Niacinamide penetrated and deposited on the surface of the hair fiber

Autoradiographic image with Caucasian, bleached hair.

Improves fiber resistance to breakage by ~4%*

Fiber break stress for CNPDA Treated hair fibers at 60% relative humidity. Data reported as mean ± SEM.

Quali-B Vitamin B3 (Niacinamide PC) Improves resilience for a healthier scalp

Strengthens Scalp Barrier:
-27% water loss reduction improving scalp hydration

TEWL was reduced by 27% when skin was treated twice daily with Niacinamide for 4 weeks

Niacinamide PC helps to keep the scalp hydrated
2% Niacinamide PC

S. Inoue. Nicotinamide increases biosynthesis of ceramides as well as other stratum corneum lipids to improve the epidermal permeability barrier, British Journal of Dermatology, 2000; 143: 524-531
**Vitamin B3 (Niacinamide PC)**

*Increased in Healthy Scalp - source of nutrients for the scalp*

Bacterial Metabolic Pathways enriched in a Healthy Scalp vs. a scalp with Dandruff

Reduction of biosynthesis and metabolism pathways of vitamins was observed in the bacterial microbiome of dandruff scalp (vs. healthy scalp).

Enrichment in vitamins via topical application could be a solution to compensate this deficiency.
Vitamin B3 (Niacinamide)

References

Penetration of Niacinamide in Hair & mechanical properties (thickening, break resistance, suppleness)
- J.H. Thomas et al., A novel cosmetic approach to treat thinning hair, British Association of Dermatologists, 2011 165 (Suppl. 3), pp24–30

Skin & Scalp Barrier improvement – Reduction of TEWL
- Z.D. Draelos, Male skin and ingredients relevant to male skin care, British Association of Dermatologists, 2012 166 (Suppl. 1), pp13–16
- S. Inoue, Nicotinamide increases biosynthesis of ceramides as well as other stratum corneum lipids to improve the epidermal permeability barrier, British Journal of Dermatology, 2000; 143: 524-531

# Quali-B Vitamin B5 (Panthenol)

## ID Card

### Key Benefit
- Scalp Care (strengthens scalp barrier / moisturization)
- Deposition – see Phytantriol
- Hair Thickening (helps increase hair diameter)

### INCI Name
- Panthenol
- Ethyl Panthenol

### Description
- D-Panthenol
- D-Panthenol 75L min 75% and water
- DL-Panthenol 50L min 50% and water/racemic mixture
- D- and L- Ethyl Panthenol

### Technical
- **Form:** Liquid
- **Use level:** Up to 2%
- **pH of use:** 4 to 7.5
- **Preservative:** Free
- **Solubility:** Water soluble
- **Target:** Hair fiber and scalp
- **Biodegradability:** Readily biodegradable

### Registration Certification

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Quality for Life™ seal that guarantees the highest standards for Quality, Reliability, Traceability, and Sustainability.
Quali-B Vitamin B5 (Panthenol)

Penetrates the hair and contributes to thicken & strengthen the fiber

Significantly increases fiber diameter*

Virgin & Fine textured hair 4%

Bleached Hair & Coarse hair 6%

*Results based in the combination of Niacinamide, caffeine, Vitamin B5, dimethicone and acrylate polymer

White represents Panthenol penetrated and deposited on the surface of the hair fiber

Autoradiographic image with Caucasian, bleached hair.

Improves fiber resistance to breakage by ~4%*

Fiber break stress for CNPDA Treated hair fibers at 60% relative humidity. Data reported as mean ± SEM.

Hair soaked in a 10% shampoo solution, rinsed twice with water and blotted with tissue paper.

**Water content (gravimetric value µg/g hair)**

- Shampoo with 0.5% Panthenol
- Shampoo with 0.3% Panthenol
- Shampoo with 0.1% Panthenol
- Shampoo base

**Implements water retention**

Moisturization level is proportional to panthenol content in formulation.
Vitamin B5 (Panthenol)
Hair Moisturization in synergy with Phytantriol

Water retention mg water/g hair

Water | Shampoo base | Shampoo with 0.1% Panthenol | Shampoo with 0.5% Panthenol | Shampoo with 0.5% Panthenol + 0.1% Phytantriol

Dilution of shampoo with water at 1:10. Hair soaked in solution, rinsed twice with water and blotted with tissue paper. Analysis of water loss gravimetrically.
**Gene**

<table>
<thead>
<tr>
<th>Gene</th>
<th>Class</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRTAP4-12</td>
<td>keratin-associated protein</td>
<td>form a matrix of keratin intermediate filaments which contribute to the structure of hair fibers</td>
</tr>
</tbody>
</table>
Vitamin B5 (Panthenol) contributes to protein loss reduction & improves combing on hair treated with oxidative hair dye.

- Panthenol reduces significantly the protein loss by around 35%.
- Panthenol reduces significantly the combing force by around 70%.

Hair untreated | treated with blond oxidative hair dye | II + 3% silanetriol and Panthenol

Caucasian light-brown hair tresses, each 20cm long, Panthenol 3% w/v added into oxidative hair dye just before use.

Vitamin B5

References

Biological effect on Keratinocytes
• R. Heise et al., Dexpanthenol Modulates Gene Expression in Skin Wound Healing in vivo, 2012, Skin Pharmacol Physiol; 25: 241–248

Penetration of Panthenol in Hair & mechanical properties (thickening, break resistance, suppleness)
• J.H. Thomas et al., A novel cosmetic approach to treat thinning hair, British Association of Dermatologists, 2011 165 (Suppl. 3), pp24–30
• da Gama RM et al., Protective effect of conditioner agents on hair treated with oxidative hair dye, J Cosmet Dermatol 2018, 17, 1090–1095
• H. Krause et al., Die percutane Absorption von tritium-markiertem Panthenol bei Mensch und Tier, Archiv fuer klinische u. experimentelle Dermatologie, 1960; 209, 578-582
• E. Wagner, Parfumerie und Kosmetik, 1994; 75:260-267
• Eggensperger, Multiaktive Wirkstoffe fuer Kosmetika-Teil II, SOEFW-Journal, 1994, 120/9, 534-538
• Eggensperger, Multiaktive Wirkstoffe fuer Kosmetika-Teil III, SOEFW-Journal, 1994, 120/16, 1013-1015

Skin barrier & hydration properties of skin
• S. Boudon et al., Topical use of dextranthenol: a 70th anniversary article, 2017, Journal of dermatological treatment, 28, 8, 766–773
### Vitamin B6 ID Card

**KEY BENEFIT**
- Sebum reduction
- Scalp Care (scaling, itch and flaking reduction)
- Hair Thickening (helps increase hair diameter)

**INCI NAME**
- Pyridoxine Hydrochloride

**DESCRIPTION**
- Vitamin

**TECHNICAL**
- **Form:** Powder
- **Use level:** Up to 0.2%
- **pH of use:** 4.5 to 7
- **Preservative:** Free
- **Solubility:** Water soluble
- **Target:** Hair fiber and scalp
- **Biodegradability:** Readily biodegradable

**REGISTRATION CERTIFICATION**
- [China] [EU] [Vegan]

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Quality for Life™ seal that guarantees the highest standards for Quality, Reliability, Traceability, and Sustainability.
Vitamin B6 is able to inhibit the DPPIV enzyme activity in a dose dependent manner.

Inhibition of DPPIV decreases neutral lipids and saturated free fatty acids in a sebocyte cell line suggesting decreased sebum synthesis.
Quali-B Vitamin B6
Promotes healthy scalp

Vitamin B6 at 0.05% reduces sebum by 6% in one single application after 4 hours

Vitamin B6 at 0.02% improves scalp conditions
- 75% Scaling reduction
- 77% Less itch
- 85% Improvement on dry dandruff

- Facial Cream – in vivo
- Half face: treated vs untreated
- Vitamin B6 at 0.025% and 0.05%
- One single application
- After rinsed-off
- Extrapolation to scalp

162 volunteers with Seborrhea capitis
0.02% Vitamin B6 in a lotion

Quali-B Vitamin B6
Scalp & Microbiome

Bacterial Metabolic Pathways enriched in a Healthy Scalp vs. a scalp with Dandruff

Reduction of biosynthesis and metabolism pathways of vitamins was observed in the bacterial microbiome of dandruff scalp (vs. healthy scalp). **Enrichment in vitamins via topical application could be a solution to compensate this deficiency.**

<table>
<thead>
<tr>
<th>Vitamin B6</th>
<th>Concentration</th>
<th>0.2%</th>
<th>1%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M. restricta</strong></td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td><strong>M. globosa</strong></td>
<td>●</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td><strong>C. acnes</strong></td>
<td>↓</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td><strong>S. capitis</strong></td>
<td>=</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td><strong>S. epidermidis</strong></td>
<td>=</td>
<td>●</td>
<td></td>
</tr>
</tbody>
</table>

incubated for 24 hours

● total antimicrobial activity
↓ decrease microbial population
= no variation

C. acnes: total antimicrobial activity at all concentrations
S. capitis and S. epidermidis: dose dependent antimicrobial performance
M. restricta and M. globosa: same performance in different use levels.
M. restricta is associated with dandruff.

Vitamin B6 = pyridoxin hydrochloride

R. Saxena et al., Comparison of Healthy and Dandruff Scalp Microbiome Reveals the Role of Commensals in Scalp Health, Frontiers in Cellular and Infection Microbiology, 2018, 8-346
In vivo studies

Quali-B Vitamin B6

Increases hair diameter

Vitamin B6 increases hair diameter around 40% in 5 weeks

- Assessed by a dermatologist on the basis of magnified hair photographs
- Topically applied on scalp
- Solution with 7.5% of Vitamin B6
- 3-5 weeks, daily use


Vitamin B6 = pyridoxin hydrochloride
Vitamin B6

References

Sebum regulation and skin/scalp benefits
• Ohta H., Pyridoxine-3,4-Diacylates and Their Use in Cosmetics. J Soc Cosmetic Chemists (1965) 16, 349–358
• Saxena et al. Comparison of Healthy and Dandruff Scalp Microbiome Reveals the Role of Commensals in Scalp Health. Front Cel Infect Microbiol (2018) 8:346
• US6403110: Siddiqui et al., 2000 USA. Topical treatment for oily skin

Hair Pigmentation & Hair thickening
• Shelley et al., Pyridoxine-Dependent Hair Pigmentation in Association With Homocystinuria (1972) 106, 228-230
• US3826834: Reiches et al., filed 1974 in USA. Use of vitamin B6 for enlarging sub-normal hair bulbs and enhancing hair growth therefrom
**Quali-Biotin Vitamins B7**

**ID Card**

<table>
<thead>
<tr>
<th>KEY BENEFIT</th>
<th>Scalp Care</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Helps prevent hair loss <em>(based on literature for oral use)</em></td>
</tr>
</tbody>
</table>

| INCI NAME        | Biotin     |

| DESCRIPTION      | Vitamin   |

| TECHNICAL        | Form: Powder |
|                  | Use level: Up to 0.5% |
|                  | pH of use: 5.5 to 8 |
|                  | Preservative: Free |
|                  | Solubility: Very slightly soluble in Water |
|                  | Target: Scalp |
|                  | Biodegradability: Not readily biodegradable |

**REGISTRATION CERTIFICATION**

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Quali-Biotin Vitamins B7
Increased in Healthy Scalp - source of nutrients for the scalp

Illustration of the mechanistic interplay observed between the scalp surface and the bacterial microbiome

The vitamins and amino acids synthesized by the microbiome were observed as a useful source of nutrients for the scalp. Biotin was observed to be majorly contributed by Propionibacterium spp. and abundance of biotin metabolism pathway significantly increase after oil-treatment and reduced with the increase in dandruff.

Bacterial Metabolic Pathways enriched in a Healthy Scalp vs. a scalp with Dandruff

Reduction of biosynthesis and metabolism pathways of vitamins was observed in the bacterial microbiome of dandruff scalp (vs. healthy scalp). Enrichment in vitamins via topical application could be a solution to compensate this deficiency.

R. Saxena et al., Comparison of Healthy and Dandruff Scalp Microbiome Reveals the Role of Commensals in Scalp Health, Frontiers in Cellular and Infection Microbiology, 2018, 8:346
Vitamin B7

References

Microbiome & Scalp Care

• R. Saxena et al., Comparison of Healthy and Dandruff Scalp Microbiome Reveals the Role of Commensals in Scalp Health, Frontiers in Cellular and Infection Microbiology, 2018, 8:346.

• C-H Chiu, A Review: Hair Health, Concerns of Shampoo Ingredients and Scalp Nourishing Treatments, Current Pharmaceutical Biotechnology, 2015, 16, 1045-1052

Seborrheic dermatitis & Hair Loss

• RM. Trüeb, Serum biotin levels in women complaining of hair loss, Int J Trichol 2016; 8: 73-77

• B. Piraccini, Biotin: overview of the treatment of diseases of cutaneous appendages and of hyperseborrhea, G Ital Dermatol Venereol, 2019, 154 (5), 557-566

• Biotin, Alternative medicine review : a journal of clinical therapeutic, 2007, 12 (1), 73-78
Quali-C Vitamin C

ID Card

**KEY BENEFIT**
Scalp Care  (anti-oxidant properties)
Blue light protection (hair fiber)
Helps prevent hair loss

**INCI NAME**
(1) Ascorbic Acid
(2) Sodium Ascorbyl Phosphate (STAY-C® 50)

**DESCRIPTION**
(1) Pure Vitamin C
(2) Monophosphate ester of ascorbic acid (vitamin C derivative with superior stability in formulations compared to straight ascorbic acid)

**TECHNICAL**
Form: Liquid
Use level: Up to 3%
PH of use: (1) 3.5 to 4  
(2) ≥ 6
Preservative: Free
Solubility: Water soluble
Target: Hair fiber and scalp
Biodegradability:
(1) Well Inherently biodegradable
(2) Not readily biodegradable

**REGISTRATION CERTIFICATION**

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Human hair follicles obtained from scalp biopsies

Vitamin C #0.25 and 1 mM/l, 9 days

CTRL Vit C 0.25 mM/l Vit C 1 mM/l

Insulin-like growth factor-1 (IGF1) expression in hair follicle

7 fold 11 fold

IGF expression (protein)

Hair follicle growth

Vitamin C stimulated the growth of cultured human hair follicle by upregulating IGF-1 up to 11 fold

CTRL Vit C 0.25 mM/l

*p<0.01 vs control

*L-Ascorbic acid 2-phosphate

• Human hair follicles obtained from scalp biopsies
• Vitamin C #0.25 and 1 mM/l, 9 days
Human hair follicles were treated with Vitamin C for 9 days. Hair length increased significantly with Vitamin C.\(^1\) *p<0.05 vs 0mM

Human dermal papilla (DP) cells were incubated with Vitamin C for 5 days. Proliferation increased significantly with Asc 2-P. *p<0.05 vs 0mM

Asc 2-P induces proliferation in cultured human hair follicles as shown by Ki67 staining (green) (b) which is not seen in vehicle treated follicles (a). (e) and (f) are the respective follicles with DAPI staining (blue) to show all the cells.\(^2\)
Cultured hair follicles were treated with Asc 2-P for 3 days.

Versican expression was up regulated in the dermal papilla (red staining indicated by red arrow heads) by immunohistochemistry.

Versican is an inducer of hair growth in the dermal papilla.

*Asc-2P: L-Ascorbic acid 2-phosphate
Vitamin C (Ascorbic Acid) clearly decreases free radicals formation induced by blue light irradiation.

Control increases free radicals by 4%, while Vitamin C treated hair decreases by 4%.

- Black hair was incubated with a solution containing 100 nM Ascorbic Acid (Test Sample II) and Control Solution (Control I).
- It was then irradiated with blue light (450 nm) and the ESR spectra was measured.
Ascorbic Acid

**LOWEST CO₂**

Compared to main alternative sources:

- Buying 1,000 tonnes of Quali-C would save 14,000 tonnes CO₂ eq.
- Equivalent to entire carbon sequestered by 210,000 tree seedlings grown for 10 years.
- 59% lower greenhouse gas emissions.

**BEFTER AIR QUALITY**

- Reduction in dust and particle matter by 92% (PM 2.5).
- Reduction in photochemical ozone formation by 79% (summer smog).

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1. Amount of greenhouse gases in CO₂-equivalents released into the atmosphere as a result of an activity. 2. This statement is based on a DSM internal Life Cycle Assessment that was independently verified by Deloitte Consultants in December 2016, and updated in May 2018.
3. This statement is based on DSM internal business intelligence using latest market insights, permits and other publications.
4. Versus main alternative sources.
Vitamin C

References

Hair growth
• Sung et al., The hair growth promoting effect of ascorbic acid 2-phosphate, a long-acting Vitamin C derivative. Journal of Dermatological Science (2006) 41, 150–152
• Kwack et al. L-Ascorbic acid 2-phosphate promotes elongation of hair shafts via the secretion of insulin-like growth factor-1 from dermal papilla cells through phosphatidylinositol 3-kinase British Journal of Dermatology 2009 160, pp1157–1162
• Kwack et al. L-Ascorbic acid 2-phosphate represses the dihydrotestosterone-induced dickkopf-1 expression in human balding dermal papilla cells, 2010, Experimental Dermatology, 19, 1103–1112
• Wakame et al. Transcriptome Analysis of Skin from SMP30/GNL Knockout Mice Reveals the Effect of Ascorbic Acid Deficiency on Skin and Hair, in vivo 31:599-607 (2017)
• Kim et al. Rice bran mineral extract increases the expression of anagen-related molecules in human dermal papilla through wnt/catenin pathway, Food & Nutrition Research, 2017, VOL. 61, 1412792
• WO2006075854: Sung et al., filed 13. January 2005 in Korea

Antioxidant & UV Protection
• Lin et al. UV photoprotection by combination topical antioxidants vitamin C and vitamin E, J AM ACAD DERMATOL, 2003, 48(6):866-874
• Chikvaidze et al. ESR study of photoinduced free radicals by visible light in hair and the effects of ascorbic acid (vitamin C), International Journal of Cosmetic Science, 2011, 33, 322–327
Vitamin E

**Key Benefit:**
- Hair Protection (protein loss/ discoloration)
- Scalp Care

**INCI Name:**
- Tocopherol
- Tocopheryl Acetate

**Description:**
- Synthetic: (1) dl-α-Tocopherol and (2) dl-α-Tocopheryl Acetate
- Natural: (3) Mixed Tocopherols 95 and (4) d-α-Tocopheryl Acetate

**Technical:**
- **Form:** Liquid
- **Use level:** Up to 1%
- **pH of use:** 3.5 to 8
- **Preservative:** Free
- **Solubility:** Oil soluble
- **Target:** Hair fiber and scalp
- **Biodegradability:** Not readily-biodegradable

**Registration Certification:**

Quality for Life™ seal that guarantees the highest standards for Quality, Reliability, Traceability, and Sustainability.
Quali®-E Vitamin E
Protects scalp against oxidative stress

**ANTI-AGING**
- Anti-oxidant properties
- Improves skin Barrier function
- Prevents peroxidation of lipids and oxidation of proteins

**ANTI-GREYING**
- ROS neutralization (literature based)
**Quali-E Vitamin E**

*Protects hair from protein loss and discoloration caused by UV and heat*

**UV and heat-induced protein loss of hair** tresses was reduced with Vitamin E-loaded NLCs.  
*p<0.05 vs Blank NLC cream*  

**Irradiation Test**

<table>
<thead>
<tr>
<th></th>
<th>Amount of Protein Loss (μg/ml of Hair)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-irradiated Hair</td>
<td>Blank-NLC’s Cream 143.85</td>
</tr>
<tr>
<td></td>
<td>Vit E-NLC’s Cream 224.84</td>
</tr>
<tr>
<td>Irradiated Hair</td>
<td>Blank-NLC’s Cream 170.97</td>
</tr>
<tr>
<td></td>
<td>Vit E-NLC’s Cream 150.03</td>
</tr>
</tbody>
</table>

**Heat Test**

<table>
<thead>
<tr>
<th></th>
<th>Amount of Protein Loss (μg/ml of Hair)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-heated Hair</td>
<td>Blank-NLC’s Cream 187.75</td>
</tr>
<tr>
<td></td>
<td>Vit E-NLC’s Cream 363.31</td>
</tr>
<tr>
<td>Heated Hair</td>
<td>Blank-NLC’s Cream 313.48</td>
</tr>
<tr>
<td></td>
<td>Vit E-NLC’s Cream 313.48</td>
</tr>
</tbody>
</table>

**UV and heat-induced discoloration of hair** tresses was reduced with Vitamin E-loaded NLCs.  
*p<0.05 vs Blank NLC cream*  

**Irradiation Test**

<table>
<thead>
<tr>
<th></th>
<th>Total Color Change (ΔE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-irradiated Hair</td>
<td>Blank-NLC’s Cream 0.4</td>
</tr>
<tr>
<td></td>
<td>Vit E-NLC’s Cream 4.34</td>
</tr>
<tr>
<td>Irradiated Hair</td>
<td>Blank-NLC’s Cream 0.38</td>
</tr>
<tr>
<td></td>
<td>Vit E-NLC’s Cream 3.39</td>
</tr>
</tbody>
</table>

**Heat Test**

<table>
<thead>
<tr>
<th></th>
<th>Total Color Change (ΔE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-heated Hair</td>
<td>Blank-NLC’s Cream 17.61</td>
</tr>
<tr>
<td></td>
<td>Vit E-NLC’s Cream 14.06</td>
</tr>
<tr>
<td>Heated Hair</td>
<td>Blank-NLC’s Cream 0.38</td>
</tr>
<tr>
<td></td>
<td>Vit E-NLC’s Cream 12.3</td>
</tr>
</tbody>
</table>

NLCs = nanostructuredlipid carriers  
Vitamin E Acetate at 0.2%  
Irradiation UVB and UVA
Vitamin E

References

Hair growth- Tocotrienol


Antioxidant & UV protection

- Prasertpol et al. Nanostructured lipid carriers: A novel hair protective product preventing hair damage and discoloration from UV radiation and thermal treatment, 2020, J Photochem Photobiol B, 204:111769
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