

4-Butylresorcinol

Alkylresorcinols are amphiphilic phenolic lipids widely found in natural plant and grain extracts. 4-Butylresorcinol is a structurally well-defined, highly potent alkylresorcinol derivative with nearly 30 years of applied research in brightening skincare and functional ingredient fields. With its exceptionally high tyrosinase inhibitory efficacy, it has become a core choice for premium skin-brightening ingredients.

4-Butylresorcinol exhibits excellent skin safety and efficacy stability. Toxicological evaluations in multiple countries have confirmed it to be non-mutagenic, non-teratogenic, and free of reproductive toxicity. It is listed in major global regulatory frameworks including the EU SCCS and China's Catalogue of Used Cosmetic Ingredients (2021 Edition), and is widely recognized as a safe and highly effective active ingredient for skin brightening, spot fading, and even-toning.

Although its application potential in brightening skincare was demonstrated long ago, large-scale use in functional skincare product development only became feasible after patent expiration and the maturation of high-purity synthesis processes. In recent years, with breakthroughs in high-purity preparation technology, 4-butylresorcinol has entered the market in high-purity ($\geq 99.5\text{--}99.9\%$) form, essentially free of irritating impurities such as resorcinol, with greatly improved formulation compatibility and skin tolerability. It has rapidly become one of the preferred ingredients for developing highly effective skin-brightening, spot-fading, and pigmentation-improving products. Multiple authoritative clinical studies have confirmed that 0.3% 4-butylresorcinol achieves significant spot-fading and brightening effects, with outstanding performance in improving melasma, solar lentigines, and post-inflammatory hyperpigmentation. Its high efficacy at low concentrations substantially reduces formulation irritation risk and cost pressure. In vitro and clinical comparative studies consistently show that the inhibitory potency of 4-butylresorcinol on human tyrosinase is significantly superior to that of phenylethyl resorcinol (377), hexylresorcinol, kojic acid, and arbutin, with faster onset of spot fading and greater degree of improvement under identical test conditions. Multiple clinical studies have confirmed that the combination of 4-butylresorcinol with actives such as niacinamide, glabridin, and undecylenoyl phenylalanine produces synergistic brightening effects, achieving multi-pathway enhancement at the levels of melanogenesis inhibition, transfer blockade, and accelerated metabolism, while simultaneously improving soothing and antioxidant performance, providing a solid scientific basis for multi-functional formulations.

Product Information

Product Name	4-Butylresorcinol
INCI Name	4-BUTYLRESORCINOL
CAS No.	18979-61-8
EC No.	606-191-2
Appearance	White to pale yellow powder
Purity	≥99%
Solubility	Dimethyl sulfoxide: 150 mg/mL (902.42 mM)
Recommended Use Level and Formulation pH	Addition level in brightening serums and creams: 0.3%–0.5%; pH: 4.5–7.0
Storage	Store in original sealed container at 10–30°C; protect from light, heat, and moisture.
Regulatory Status	Globally recognized

Human Skin Tolerability

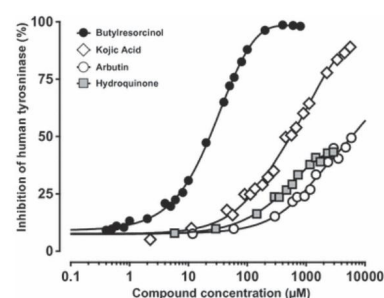
Safety assessment based on MOS values: Compared with 1% kojic acid (MOS=88), 1% 4-butylresorcinol was found to be safe for topical application (MOS=692). MOS values of 100 and above are considered safe. MOS was calculated for facial products at a 1% usage level.

Human Repeat Insult Patch Test (HRIPT) for evaluating allergy/skin irritation/skin sensitization: (0.5%, 1%, 2% in corn oil); 4-butylresorcinol was found to be a non-primary irritant and non-primary sensitizer.

Chamber scratch test for evaluating skin irritation propensity: (0.1% and 0.5% in petrolatum) on scratched skin; 4-butylresorcinol was found to have low irritation potential, performing well compared with the saline control.

In Vitro Enzyme Inhibitory Activity

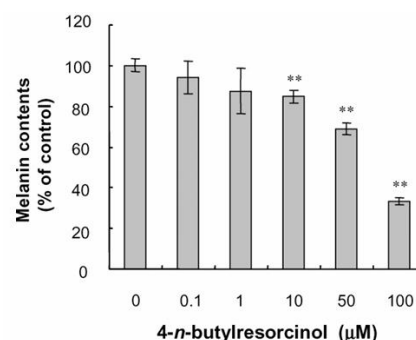
- **Enzyme** — Human tyrosinase
- **Substrate** — L-DOPA
- **Test substances** — 4-Butylresorcinol, hydroquinone, kojic acid, arbutin
- **Measurement** — Spectrophotometry; spectral range 490 nm
- **Performance quantification** — Half maximal inhibitory concentration (IC₅₀), i.e., the concentration required to inhibit 50% of enzyme activity of the sample



4-Butylresorcinol is the most potent human tyrosinase inhibitor among the tested compounds, with inhibitory activity surpassing hydroquinone, kojic acid, and arbutin.

In Vitro Melanin Inhibitory Activity

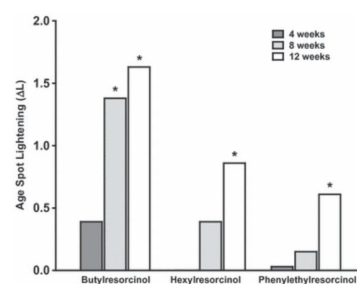
- **Cells** — Mel-Ab immortalized mouse melanocytes
- **Incubation time** — Continuous incubation with test substance at 37°C, 5% CO₂ for 4 d (96 h); cell viability assay incubated for 24 h
- **Test substance** — 4-Butylresorcinol
- **Measurement** — 590 nm
- **Performance quantification** — Half maximal effective concentration (EC₅₀), i.e., the concentration required to inhibit 50% of melanin synthesis



4-Butylresorcinol safely and effectively inhibits melanin synthesis in melanocytes, making it an outstanding brightening active ingredient.

Human Skin Brightening Clinical Trial

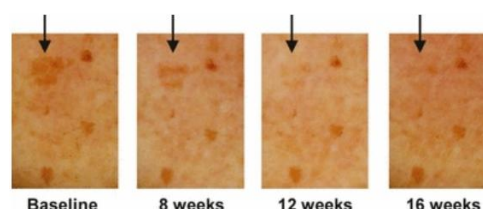
- **Volunteers** — 14 subjects
- **Study duration** — 12 weeks, assessed at weeks 4, 8, and 12
- **Test site** — Senile plaque lesions on both forearms
- **Test substance** — 0.3% 4-butylresorcinol emulsion; blank vehicle control group;
- **Parallel control group** — 0.3% 4-hexylresorcinol, 0.5% phenylethyl resorcinol emulsion;
- **Frequency of use** — Twice daily
- **Performance quantification** — Colorimeter measurement of ITA° skin tone values + Epi-Flash high-definition imaging archive of local pigmented spots



0.3% 4-Butylresorcinol produces significant spot-fading and brightening effects after 8 weeks of use, with faster onset than 4-hexylresorcinol at the same concentration and 0.5% phenylethyl resorcinol. Mild transient erythema was occasionally observed during the trial and resolved spontaneously.

Clinical Study on Hyperpigmentation Control

- **Volunteers** — 14 subjects
- **Study duration** — 16 weeks, assessed at weeks 8, 12, and 16
- **Test site** — Senile plaque lesions on both forearms
- **Test substance** — 0.3% 4-butylresorcinol emulsion; blank vehicle control group;
- **Parallel control group** — 0.3% 4-hexylresorcinol, 0.5% phenylethyl resorcinol emulsion;
- **Frequency of use** — Twice daily
- **Performance quantification** — Colorimeter measurement of ITA° skin tone values + Epi-Flash high definition imaging archive of local pigmented spots



After 4 weeks of treatment, treated spots were lighter than control spots. Improvement continued throughout the treatment period, and after 16 weeks some spots could no longer be distinguished from the surrounding skin.

Reduction of Skin Hyperpigmentation in Korean Subjects

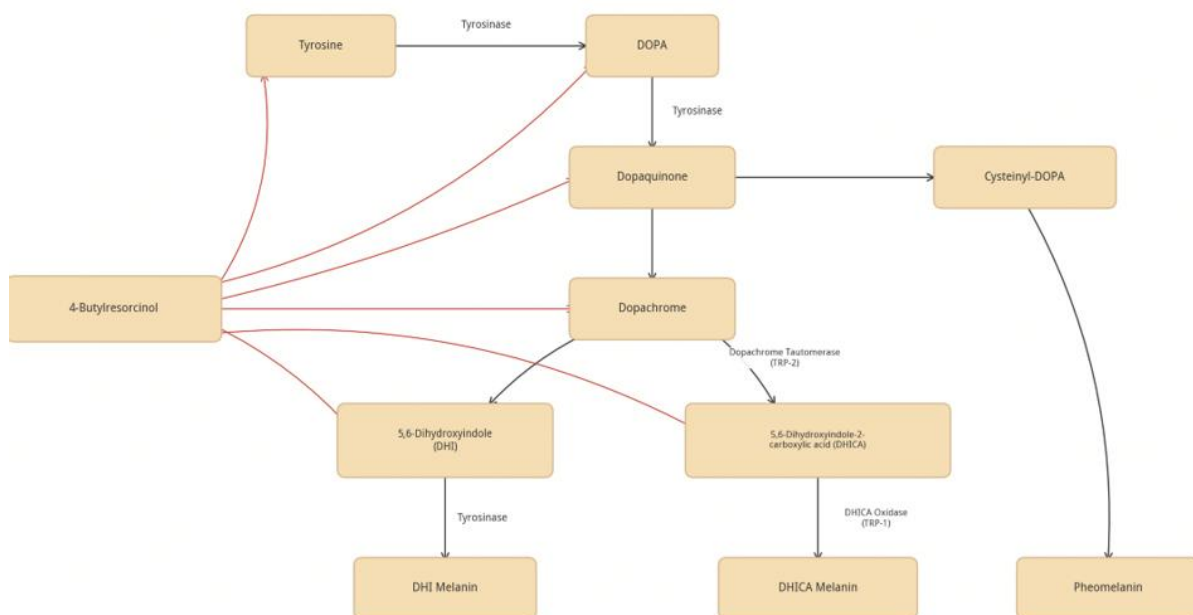
- **Volunteers** — 20 Korean subjects
- **Study duration** — 8 weeks
- **Test site** — Full face (split-face design, left and right halves)
- **Test substance** — 0.1% 4-butylresorcinol cream VS blank vehicle cream
- **Frequency of use** — Twice daily
- **Performance quantification** — Mexameter melanin index measurement, standardized digital photography, clinical visual assessment: spot area, pigment depth, contrast between lesion and surrounding skin, full-face evenness and brightening degree



After 8 weeks of continuous use, the melasma pigmentation index on the treated side significantly decreased, with marked improvement in spot area and pigment intensity. Only a few subjects experienced brief mild erythema, which was self-limiting; overall safety was good.

Multiple Pathways Affecting Melanogenesis

4-Butylresorcinol inhibits all other sites in the melanogenic pathway. 4-Butylresorcinol modulates the above eight sites in the melanogenesis pathway, simultaneously blocking both the eumelanin (DHI, DHICA melanin) and pheomelanin synthesis branches.



Recommended Synergists/Additives for Enhancing Skin Brightening/Even-Tone Effects

Synergist/Additive	Rationale/Mechanism	Use Level
Tranexamic Acid	Inhibits inflammation- and UV-induced release of melanogenic factors, downregulates melanocyte activation, and reduces melanogenesis upstream. Forms an upstream-downstream synergistic brightening effect with the enzyme-inhibitory pathway of 4-butylresorcinol, reducing inflammatory	2%
Niacinamide	Blocks melanosome transfer from melanocytes to keratinocytes, impedes deposition of synthesized melanin, and complements the synthesis-inhibitory target of 4-butylresorcinol. Clinical combination significantly accelerates skin brightening and fades pigmented spots.	3%
Acetylzingerone	A non-depleting broad-spectrum antioxidant that chelates copper ions, a key cofactor of tyrosinase, thereby inhibiting copper-mediated melanogenesis. Protects against UV-induced damage, soothes redness in photo-damaged skin, and assists in fading freckles and solar pigmentation.	1%

A Truly Multifunctional Skin-Brightening/Even-Tone Active Ingredient

Safe and Effective Skin Brightening Agent / Even-Tone Active

- Nearly 30 years of compliant cosmetic application history worldwide; listed in multiple national pharmacopoeias / cosmetic ingredient catalogues.
- In vitro tyrosinase inhibitory efficacy at the same concentration is approximately 4 times that of hydroquinone; a low-irritation, compliant alternative to hydroquinone.
- Clinically validated across all skin types: suitable for healthy skin, inflammatory hyperpigmentation, post-acne hyperpigmentation, and melasma-prone skin.

Skin Protection

- Scavenges skin ROS, reduces oxidation-induced DNA oxidative damage, and assists in repairing photo-damaged cells.
- Increases endogenous glutathione (GSH) levels in skin, strengthening the cellular antioxidant barrier.
- Reduces cross-linking between free sugars and proteins, inhibits AGE glycation, and improves glycation-induced dullness and yellowing.
- Antioxidant activity indirectly downregulates pro-inflammatory factors without directly inhibiting the

NF- κ B pathway, alleviating inflammation-induced hyperpigmentation.

Anti-Aging Benefits

- Inhibits UV-induced oxidative degradation of collagen/elastin, maintaining dermal fiber integrity.
- Multiple human clinical studies: improves multiple signs of aging including photoaging spots, uneven skin tone, roughness, and dullness.

Key Publications

1. Kolbe L, et al. 4-n-butylresorcinol, a highly effective tyrosinase inhibitor for the topical treatment of hyperpigmentation. *J Eur Acad Dermatol Venereol*. 2013;27(Suppl 1):19–23.
2. Kim DS, et al. Inhibitory effects of 4-n-butylresorcinol on tyrosinase activity and melanin synthesis. *Biol Pharm Bull*. 2005;28(12):2216–2219
3. Huh SY, et al. The Efficacy and Safety of 4-n-butylresorcinol 0.1% Cream for the Treatment of Melasma: A Randomized Controlled Split-face Trial. *Ann Dermatol*. 2010;22(1):21-25