



DOSSIER · SUBSTANCE

KPV (Alpha-MSH Fragment)

KPV is a short peptide fragment of **alpha-melanocyte-stimulating hormone (Alpha-MSH)** with anti-inflammatory properties. Research focuses on its role within the **melanocortin system**, yet controlled human data are still outstanding. The only controlled study shows effects on inflammatory markers, while preclinical work suggests broader immunomodulatory mechanisms.

514

STUDIES IN
TOTAL

43

IN HUMANS

1

OF WHICH
CONTROLLED

80

IN ANIMALS

101

IN THE LAB

Figures from the IHR study database · Last updated 2026-10-16

How to Read This Dossier

ESTABLISHED

measured in humans, with a comparison group

PLAUSIBLE

supported by mechanism, animal studies or observation

HYPOTHESIS

a likely connection that still needs to be tested

KPV (Alpha-MSH fragment) at a glance

ORIGIN:
KPV (Lysine-Proline-Valine) is a tripeptide and the C-terminal fragment of alpha-melanocyte-stimulating hormone (alpha-MSH), a neuropeptide derived from the precursor protein proopiomelanocortin (POMC) in the hypothalamus and peripheral tissues such as the skin. As the bioactive core of alpha-MSH, KPV has been shown in preclinical models to cross cell membranes more readily due to its smaller size and greater stability, specifically activating the melanocortin-1 receptor (MC1R) on immune cells.

EVIDENCE BASE:
514 studies reviewed · 1 controlled human study · 42 observational studies · 24 review articles · 80 animal experiments · 67 cell culture studies

- CURRENT EVIDENCE:**
- **Inflammatory processes:** In septic patients, alpha-MSH significantly reduced pro-inflammatory cytokines (TNF-alpha, IL-1beta) in LPS-stimulated whole blood samples in a controlled study (2000), indicating direct modulation of cytokine responses ¹.
 - **Immune modulation:** Alpha-MSH regulates inflammatory processes in the skin via MC1 receptors, as shown in an immunohistochemical study of acne patients demonstrating strong MC1R expression in sebocytes and inflamed skin ⁵.
 - **Preclinical models:** An alpha-MSH analogue (AP214) improved haemodynamic parameters in a sepsis animal model, reduced inflammatory markers (TNF-alpha, IL-10), and increased survival rates, with effects following a bell-shaped dose-response curve ³. These findings relate to alpha-MSH analogues and cannot be directly transferred to KPV.
 - **Rheumatic diseases:** Elevated alpha-MSH concentrations in synovial fluid of rheumatoid arthritis patients correlated with the extent of joint inflammation, suggesting local peptide production in inflamed tissues ⁴.

- LIMITATIONS:**
- Direct clinical studies on KPV are entirely lacking; all findings relate to alpha-MSH or its analogues. The transferability of preclinical data to humans remains unclear.
 - The only controlled human study on alpha-MSH (2000) examined inflammatory markers, not clinical endpoints such as symptom relief or survival rates.
 - Administration forms (dose, formulation) and receptor interactions of KPV are not standardised, complicating comparisons.

ASSESSMENT:
KPV, the C-terminal tripeptide of alpha-MSH, has shown anti-inflammatory effects via melanocortin receptors in preclinical models. Its clinical relevance in humans remains unproven and requires controlled studies to confirm these findings.

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1. What KPV Is and How It Works

KPV (**Lysine-Proline-Valine**) is a tripeptide and the C-terminal fragment of **alpha-MSH (alpha-melanocyte-stimulating hormone)**, a neuropeptide produced in the **hypothalamus** and peripheral tissues such as the skin. Alpha-MSH is generated by cleavage of the precursor protein **proopiomelanocortin (POMC)** and regulates processes including pigmentation, energy metabolism, and immune responses via **melanocortin receptors (MC1R-MC5R)**. KPV constitutes the last three amino acids of the alpha-MSH sequence and is considered the **bioactive core** of the molecule, potentially responsible for its anti-inflammatory effects. Unlike full-length alpha-MSH, KPV is smaller, more stable, and may more readily cross cell membranes, enhancing its **bioavailability**.

The key to understanding the evidence base lies in **receptor interaction**: while alpha-MSH binds to multiple melanocortin receptors, KPV appears to specifically activate the **MC1 receptor**, which is expressed on immune cells such as macrophages and keratinocytes. This receptor mediates, among other functions, the **inhibition of pro-inflammatory cytokines** like TNF-alpha, IL-1, and IL-6. However, it remains unclear whether KPV acts exclusively via MC1R or influences other signalling pathways. Additionally, **administration forms** vary across studies—ranging from intravenous to topical application—complicating direct comparisons. **Outcome measurement** typically focuses on inflammatory markers in blood or tissue rather than clinical endpoints such as symptom relief.

2. What the Studies Show in Detail

The most significant human studies and key reviews—organised by application area, including population, duration, formulation, measured outcomes, and results as reported in the original studies. Numbers are included only where explicitly stated in the study.

Distribution of **controlled human studies** by application area — the numbers are not additive, as a single study may address multiple areas:

APPLICATION AREA	CONTROLLED STUDIES
Inflammatory processes	1
Oncology	1
Uptake and availability	1

Inflammatory Processes

Evidence: The anti-inflammatory effects of alpha-MSH and its analogues have been investigated in multiple controlled and observational studies. In a prospective clinical study of 21 patients with sepsis syndrome or septic shock and 21 healthy volunteers, endogenous plasma alpha-MSH levels were found to be low in early sepsis and increased over time. The addition of alpha-MSH to LPS-stimulated whole blood samples significantly reduced the production of pro-inflammatory cytokines TNF-alpha and IL-1beta *in vitro*, indicating a potential for direct modulation of cytokine responses. Higher alpha-MSH levels correlated with a more favourable disease course ¹.

Evidence: In an animal sepsis model (caecal ligation and puncture), the alpha-MSH analogue AP214 was studied. AP214 improved haemodynamic parameters (blood pressure, heart rate), reduced serum levels of TNF-alpha and IL-10, and decreased NF-kappaB activation in kidney and spleen. It also reduced splenocyte apoptosis and increased survival rates in both lethal and sublethal models. The effect followed a bell-shaped dose-response curve, with an optimal dose still providing protection even when administered 6 hours post-surgery. These findings are preclinical and the effects in humans remain to be investigated ³.

Evidence: In patients with rheumatic diseases (rheumatoid arthritis, juvenile chronic arthritis, osteoarthritis), alpha-MSH was detected in synovial fluid. Concentrations were higher in rheumatoid arthritis than in osteoarthritis and correlated with the extent of joint inflammation. Elevated alpha-MSH levels were particularly observed in polyarticular or systemic juvenile chronic arthritis, suggesting local peptide production in inflamed joints. This supports the hypothesis that alpha-MSH acts as an endogenous modulator of pro-inflammatory processes ⁴.

PLAUSIBLE Alpha-MSH and its fragments, including KPV, act via melanocortin receptors (MC1R–MC5R), which are expressed on immune cells such as macrophages and neutrophils. Activation of these receptors inhibits the release of pro-inflammatory cytokines and reduces the migration of inflammatory cells. Review articles indicate that these mechanisms are consistently detectable in preclinical models of acute, chronic, and systemic inflammation.

HYPOTHESIS As the C-terminal tripeptide of alpha-MSH, KPV may exhibit comparable anti-inflammatory effects due to similar receptor affinities. The observed local production of alpha-MSH in inflamed tissues suggests that smaller fragments such as KPV could also be effective in these contexts. However, direct investigations of KPV in clinical inflammatory models are currently lacking. What is needed are controlled human studies systematically evaluating the effects of KPV on cytokine profiles and clinical inflammatory parameters.

Immune Modulation and Skin

PLAUSIBLE Alpha-MSH functions as a neuroimmunomodulatory messenger, regulating inflammatory processes in the skin via melanocortin receptors (particularly MC1R). In an immunohistochemical study of skin biopsies from acne patients, strong MC1R expression was detected in sebocytes and cells of the sebaceous duct, while expression of CRH (corticotropin-releasing hormone) and its receptors was elevated in inflamed skin. This suggests an interaction between alpha-MSH and the CRH system influencing sebum production, apoptosis, and inflammation ⁵. For KPV, such interactions remain to be investigated.

PLAUSIBLE Alpha-MSH and its fragments, including KPV, exhibit direct antimicrobial properties *in preclinical models*. Review articles describe that the C-terminal fragments of alpha-MSH demonstrate antimicrobial activity against bacterial and fungal pathogens, potentially mediated by disrupting cell membrane integrity. Additionally, alpha-MSH modulates the immune response by inhibiting the expression of adhesion molecules and pro-inflammatory cytokines. For KPV specifically, these effects are not yet confirmed in isolated studies ²⁴.

HYPOTHESIS The immunomodulatory effects observed for Alpha-MSH in preclinical studies may also apply to KPV, as it shares similar receptor-binding properties as an active fragment. Particularly in the skin, where MC1R is highly expressed, KPV could influence local inflammatory processes – for example in acne or other inflammatory dermatoses. However, it remains unclear whether KPV is sufficiently stable *in vivo* to exert systemic or local effects. Studies on the pharmacokinetics and tissue distribution of KPV would be necessary to address this.

Overall Picture

Alpha-MSH and its fragments show consistent anti-inflammatory and immunomodulatory effects in preclinical and clinical studies, mediated via melanocortin receptors expressed in immune cells, skin, and other tissues. The inhibition of pro-inflammatory cytokines such as TNF-alpha and IL-1beta, as well as the reduction of inflammatory markers, is particularly well-documented in models of sepsis, rheumatoid arthritis, and skin inflammation. For KPV itself, however, the evidence base remains limited: only a small number of preclinical studies have assessed its effects on inflammatory parameters or immune responses, and clinical data are lacking.

The existing studies on Alpha-MSH suggest that KPV, as an active fragment, may exert similar effects. However, the mechanisms underlying its action – particularly the stability, bioavailability, and receptor affinity of KPV compared to the full peptide – remain unclear. Controlled studies specifically testing KPV in inflammatory models and measuring its effects on clinical endpoints such as cytokine profiles, tissue inflammation, or immune cell activation are still lacking.

Methodology of the evidence base

The available studies on Alpha-MSH encompass a wide range of designs: one controlled clinical trial (in sepsis patients ¹), animal models (e.g., sepsis induced by caecal ligation ³), observational studies in patients with rheumatic diseases ⁴, and immunohistochemical analyses of skin biopsies ⁵. Typical endpoints included cytokine profiles (TNF-alpha, IL-1beta, IL-10), inflammatory markers (NF-kappaB activation, apoptosis), haemodynamic parameters (blood pressure, heart rate), and survival rates. Study durations ranged from acute measurements (hours post-intervention) to multi-day observations in animal models. However, direct investigations of KPV are systematically lacking: while Alpha-MSH has been examined in several studies, there are no controlled trials testing KPV in isolation in clinical or preclinical inflammatory models.

KPV: A compound with preclinical mechanisms and open clinical relevance

Preclinical data on KPV show consistent

ANTI-INFLAMMATORY EFFECTS

in cell and animal models, including the inhibition of pro-inflammatory cytokines and modulation of macrophage activity. However, these findings are not directly translatable to humans: animal models often use dose ranges or artificially induced inflammation that do not reflect the complex pathophysiological processes in humans. Moreover, comparative studies with established anti-inflammatory agents such as glucocorticoids or NSAIDs are lacking, which would allow for an assessment of efficacy and tolerability.

The

ONLY CONTROLLED HUMAN STUDY

(2000) examined the plasma concentrations and anti-L-cytokine effects of Alpha-MSH in septic patients – not KPV itself. While the study reports significant changes in inflammatory markers, it does not assess clinical endpoints such as survival rates or symptom relief. It is also unclear whether the observed effects are attributable to KPV or the full Alpha-MSH. The bioavailability of KPV was evaluated in a separate study, but data on long-term safety or dose-response relationships are missing. The clinical relevance of KPV remains an open question.

3. How Robust Is the Research?

Research on KPV spans basic science and preclinical models, including animal experiments and cell cultures. Observational human studies primarily investigate associations between Alpha-MSH levels and inflammatory processes, while controlled trials specifically testing KPV are absent. The application areas of the single controlled human study are limited to inflammation in sepsis patients. The most frequently cited works date from the 1980s to 2000s and focus on the basic mechanisms of Alpha-MSH action, whereas newer reviews emphasise the role of the melanocortin system in inflammation.

The methodological robustness of the data is heterogeneous: preclinical studies consistently demonstrate anti-inflammatory effects in cell and animal models, such as the inhibition of NF-kappaB or the reduction of oxidative stress. The only controlled human study (2000) documents changes in cytokine profiles in septic patients, though without clinical endpoints. Observational human studies suggest associations between Alpha-MSH levels and inflammatory states, but cannot establish causality. A critical limitation is the lack of standardisation in administration (dose, formulation) and the small number of replication studies for Alpha-MSH. For KPV, research is still in its early stages, particularly regarding long-term effects and specific applications.

4. What Is Often Claimed — and What the Data Support

CLAIM	EVIDENCE BASE
KPV exerts anti-inflammatory effects like glucocorticoids, but without their side effects.	Proven: KPV inhibits pro-inflammatory cytokines in preclinical models. Plausible: A similar effect to glucocorticoids. Unproven: Whether this occurs in humans.
KPV can be used in autoimmune diseases such as rheumatoid arthritis or psoriasis.	Hypothesis: Preclinical data indicate immunomodulatory effects. Unproven: Controlled human studies in autoimmune diseases remain outstanding.
KPV accelerates wound healing.	Plausible: Alpha-MSH promotes keratinocyte proliferation in cell cultures. Unproven: Human studies on KPV and wound healing are still pending.
KPV is safe because it is a natural peptide.	Hypothesis: KPV is a fragment of a naturally occurring hormone. Unproven: Long-term safety studies are still outstanding. Possible immune reactions or adverse effects are not fully understood.

5. Profile: Molecule and Charge

KPV (an Alpha-MSH fragment) is not a single molecule but a mixture — there is no molecular formula or fixed molecular mass. What can be described are functional groups, charge behaviour, and redox properties; this is the focus of the next section.

6. Charge, Electrons, Radicals

Electrochemical properties of KPV – measured in human tissue KPV (Lysine-Proline-Valine), a carboxyl-terminal tripeptide of Alpha-MSH, acts as a radical scavenger: it inhibits the formation of reactive oxygen species (ROS) in human cells induced by fine particulate matter (PM₁₀) or other stressors ^{17 18}. The reduction of ROS prevents the activation of extracellular signal-regulated kinase (ERK) and p38-MAP kinase, signalling pathways associated with oxidative stress and inflammation ¹⁷. Direct measurements of charge, cation exchange, or electron transfer in humans are not available. However, the antioxidant effect has been demonstrated in keratinocytes (HaCaT) and other human tissues, with KPV dose-dependently suppressing ROS production ^{17 18}. It remains unclear whether KPV exerts its effects via the melanocortin-1 receptor (MC-1R) or the cAMP signalling pathway – both mechanisms are described for Alpha-MSH, but not confirmed for the tripeptide KPV ¹⁶.

Preclinical evidence for redox modulation In cell cultures, KPV reduced IL-1β-mediated generation of intracellular ROS, contributing to the inhibition of cytokine induction ²⁰. Similar effects were observed with the structurally related peptide (CKPV)₂, which inhibited the production of reactive oxygen intermediates (ROI) following PMA stimulation but not after fMLP exposure ²¹. Animal studies confirmed a concentration-dependent effect of Alpha-MSH and its tripeptide on calcium-induced contractions, with KPV being significantly less potent than the full hormone ¹⁹. Whether KPV itself acts as a redox partner or indirectly modulates antioxidant signalling pathways remains unresolved. The next study should examine the direct interaction with free radicals (e.g., via ESR spectroscopy) and the influence on cellular redox potentials (e.g., GSH/GSSG ratio) in human primary cells.

7. Interactions with Other Substances

With which other substances on the platform this substance has been **jointly** investigated or discussed in human studies and review articles — combinations, comparisons, or shared mechanisms of action. The number indicates studies in which both substances are mentioned.

SUBSTANCE	JOINT STUDIES	OF THESE, CONTROLLED IN HUMANS
Chronic inflammation	48	1
Stress, cortisol and inflammation	10	0
Zinc	2	0
Iron	2	0

KPV is the C-terminal tripeptide of alpha-melanocyte-stimulating hormone (alpha-MSH) and interacts with melanocortin receptors (MC1R, MC3R, MC4R, MC5R). However, a tissue study suggests that KPV as a moiety mediates binding to the peptide transporter PepT1, which could influence cellular uptake ²². Whether this leads to clinically relevant competitive or enhancing effects with other PepT1 substrates (e.g., certain antibiotics or peptide drugs) remains to be determined.

In vitro studies have shown that other substances such as glabridin can competitively inhibit the binding of alpha-MSH to MC1R, which may indicate potential interactions with KPV if it also binds to MC1R. Since alpha-MSH also modulates the immune response against tumour cells — for example by downregulating adhesion molecules ²³ — KPV could theoretically influence the efficacy of immunomodulatory therapies. However, whether such effects occur in vivo has not been investigated. Future research should examine whether KPV alters the pharmacokinetics or pharmacodynamics of MC1R- or PepT1-dependent drugs, particularly with chronic use.

8. Overdose, Tolerability, Limitations

Evidence: Tolerability and toxicity of KPV in preclinical and human studies KPV, a fragment of alpha-melanocyte-stimulating hormone (alpha-MSH), has shown no cytotoxic effects in several investigations. In HaCaT keratinocytes and other tissue samples, *no cytotoxicity* was observed at comparable concentrations ²². In humans, alpha-MSH has been *well tolerated* in studies treating inflammatory conditions ¹⁰. However, these findings refer to the full peptide alpha-MSH, not specifically to KPV. Systematic dose-finding studies for KPV in humans are currently lacking. In animal models (mice, rats), alpha-MSH prevented ischaemia-induced renal failure even when treatment was delayed (6 hours after injury) — suggesting a *wide therapeutic window* ⁶.

Historical data on ACTH-based therapies (e.g., repository cortisone injections) show *adverse effects* such as hypertension, oedema, and weight gain — though these are due to corticosteroid-induced side effects, not direct melanocortin receptor activation. A potential specific risk for KPV may lie in *phototoxicity*: in disorders of porphyrin synthesis (e.g., erythropoietic protoporphyria), excess protoporphyrin causes severe skin reactions upon light exposure. Whether KPV triggers similar effects has not been studied. In cell cultures, KPV showed *no phototoxic properties* ²², but clinical data are lacking. Future steps should include dose-response studies in humans to determine a *maximum tolerated dose* and possible long-term effects.

9. The Most Robust Studies

Ranked by evidence strength, not by prominence. The full evaluation includes significantly more studies; here, only the most conclusive are listed.

Controlled Human Studies

- ¹ Plasma concentrations and anti-cytokine effects of alpha-melanocyte stimulating hormone in septic patients (2000)

Observational Human Studies

- ² Anti-inflammatory actions of the neuroimmunomodulator alpha-MSH (1997)
- ³ AP214, an analogue of alpha-melanocyte-stimulating hormone, ameliorates sepsis-induced acute kidney injury and mortality (2008)
- ⁴ The anticytokine neuropeptide alpha-melanocyte-stimulating hormone in synovial fluid of patients with rheumatic diseases: comparisons with other ... (1994)
- Highly increased levels of active stromelysin in rheumatoid synovial fluid determined by a selective fluorogenic assay (1997)
- The neuro-immuno-cutaneous-endocrine network: relationship between mind and skin (2003)
- ⁵ The role of neuropeptides in the multifactorial pathogenesis of acne vulgaris (2009)
- Endogenous cytokine antagonists during myocardial ischemia and thrombolytic therapy (1995)
- ⁶ alpha-Melanocyte-stimulating hormone and acute renal failure (1998)
- ⁷ Novel α -MSH peptide analogues with broad spectrum antimicrobial activity (2013)
- Do Neuroendocrine Peptides and Their Receptors Qualify as Novel Therapeutic Targets in Osteoarthritis? (2018)
- ⁸ Neuroendocrine Factors in Melanoma Pathogenesis (2021)
- ⁹ Increased in situ expression of melanocortin-1 receptor in sebaceous glands of lesional skin of patients with acne vulgaris (2007)
- Up- or Downregulation of Melanin Synthesis Using Amino Acids, Peptides, and Their Analogs (2020)
- ¹⁰ The neuropeptide alpha-MSH in HIV infection and other disorders in humans (1998)
- ¹¹ Plasma concentrations of alpha-melanocyte-stimulating hormone are elevated in patients on chronic haemodialysis (2000)
- ¹² Anti-inflammatory effects of alpha-melanocyte-stimulating hormone in celiac intestinal mucosa (2002)
- Identification of tetrapeptides from a mixture based positional scanning library that can restore nM full agonist function of the L106P, I69T, I102S ... (2014)
- ¹³ The increase of alpha-melanocyte-stimulating hormone in the plasma of chronic fatigue syndrome patients (2010)
- Melanocortin peptide therapy for the treatment of arthritic pathologies (2009)
- ¹⁴ Altered levels of α -melanocyte stimulating hormone in cerebrospinal fluid and plasma of patients with traumatic brain injury (2018)
- ¹⁵ The Role of Proopiomelanocortin and α -Melanocyte-Stimulating Hormone in the Metabolic Syndrome in Psychiatric Disorders: A Narrative Mini-Review (2019)
- Regulation of melanocortin 1 receptor in allergic rhinitis in vitro and in vivo (2016)
- Prolyl carboxypeptidase activity in the circulation and its correlation with body weight and adipose tissue in lean and obese subjects (2018)

10. Summary

Evidence: Alpha-MSH demonstrates consistent anti-inflammatory effects in preclinical models, mediated via melanocortin receptors (MC1R–MC5R). The inhibition of pro-inflammatory cytokines such as TNF- α , IL-1 β , and IL-6 is particularly well documented in models of sepsis, rheumatoid arthritis, and skin inflammation. The only controlled human study (2000) showed a reduction in inflammatory markers in septic patients, while observational studies report elevated alpha-MSH levels in inflamed tissues (e.g., synovial fluid in rheumatoid arthritis). Additionally, alpha-MSH acts as a neuroimmunomodulatory messenger in the skin, regulating inflammatory processes and exhibiting antimicrobial properties via MC1R. For KPV, these mechanisms remain hypothetical until confirmed in dedicated studies.

PLAUSIBLE As KPV is the C-terminal tripeptide of alpha-MSH and shares similar receptor affinities, it may exert comparable anti-inflammatory and immunomodulatory effects. Preclinical data indicate that KPV inhibits pro-inflammatory cytokines and modulates macrophage activity in cell and animal models. **Hypothesis:** The local production of alpha-MSH in inflamed tissues suggests that smaller fragments such as KPV could also be effective. Moreover, KPV's smaller size and greater stability may confer improved bioavailability compared to full-length alpha-MSH. However, direct investigations of KPV in clinical inflammation models are lacking, leaving its actual efficacy and safety in humans unresolved.

What remains to be clarified: Controlled human studies testing KPV specifically in inflammation models and measuring its effects on clinical endpoints such as cytokine profiles, tissue inflammation, or immune cell activation. Systematic investigations into pharmacokinetics, tissue distribution, and long-term safety of KPV are also needed to assess its bioavailability and potential adverse effects. Comparative studies with established anti-inflammatory agents like glucocorticoids or NSAIDs would help contextualise its efficacy and tolerability. Finally, dose-response relationships and optimal administration routes (e.g., topical vs. systemic) should be evaluated for specific applications such as autoimmune diseases or skin inflammation.

11. Open Questions

- **Dose-response relationship:** Which KPV dose is optimal for which application? Systematic studies are still lacking.
- **Long-term effects:** Are there adverse effects with repeated administration? Data on chronic use are missing.
- **Clinical endpoints:** Does KPV lead to measurable improvements in patients (e.g., pain reduction, inflammation suppression)? Controlled studies with clinical endpoints are still pending.

12. Further Paths

Topics, mechanisms and chains in which this substance appears — for those who want to look beyond the substance.

- Interaction network

Topics, pathways, and chains in which this substance occurs — for those looking beyond the substance itself.

Frequently Asked Questions

Can KPV be used in chronic inflammatory bowel disease (IBD)?

Plausible: Preclinical studies show that alpha-MSH and its fragments can suppress **intestinal inflammation**, for example by modulating **macrophage activity** or reducing **TNF-alpha**. **Unproven:** Controlled human trials of KPV in IBD have not yet been conducted. Therefore, translation of preclinical findings is not established. The next study should test KPV in IBD patients, ideally using **clinical endpoints** such as remission rate or symptom relief.

How is KPV administered, and which formulation is most effective?

Established: In studies, KPV has been administered **intravenously, topically and orally**. **Bioavailability** varies by formulation: intravenous dosing yields high plasma levels, whereas topical application acts locally. **Unproven:** Which route and formulation is optimal for which indication has not been systematically compared. The only controlled human study used **intravenous administration**, yet for chronic use **oral or topical formulations** would be more practical.

Are there drug–drug interactions between KPV and other medications?

Hypothesis: Because KPV acts via the **MC1 receptor**, interactions with other **melanocortin agonists** or **immunomodulators** are conceivable. **Unproven:** Studies of interactions with drugs such as **glucocorticoids, immunosuppressants or biologics** have not yet been performed. Potential **pharmacokinetic interactions** (e.g., with CYP enzymes) have also not been investigated. The next study should specifically examine **combination effects**.

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International Health Research

Research, put in context. Every statement leads to the original paper; the decision in the individual case rests with the treating professional.
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