

EDAX quantitation of phosphorus is an objective biomarker for psoriatic disease activity and treatment response

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1. Article

Phosphorus is an essential mineral for cell function and life. It is a structural component of DNA and RNA (1) and is integral to adenosine triphosphate, the molecule responsible for storing and releasing energy for nearly all cellular processes (2). Cell membranes are composed of phospholipids, which maintain membrane integrity and regulate transport across the membrane (3). Phosphorylation—the addition of phosphate groups to proteins—plays a central role in regulating cell division and enzyme activation (4) and is fundamental to intracellular signal transduction (5).

Psoriasis is a common inflammatory skin disease affecting approximately 2% of the population (6). At the cellular level, psoriatic skin demonstrates disrupted metabolism and signaling. Phosphorus contributes significantly to these alterations. Psoriatic lesions exhibit increased phosphorylase kinase activity, promoting protein activation and keratinocyte proliferation (7). This results in delayed differentiation and expansion of epidermal layers (8). Inflammatory signaling pathways, including NF- κ B and MAPK, are also upregulated (9). Elevated ATP turnover further increases phosphorus utilization and metabolic activity (10). Collectively, phosphorus acts as a biochemical stimulant in psoriasis, driving proliferation, inflammation, and abnormal epidermal maturation.

Therapeutic efficacy in psoriasis is typically assessed using clinical scoring systems such as PASI, BSA, DLQI, PGA, SAPASI, and PEST (11). However, few objective tests exist to quantify treatment response (12). An objective biomarker would be valuable for comparing topical and systemic therapies and could help distinguish true therapeutic improvement from placebo effects or spontaneous remission.

Non-visual diagnostic tools include HCA-27 and cytokine profiling (13), as well as genetic markers such as PSORS1 on chromosome 6 (14). Interleukin-36 gamma immunohistochemistry can support diagnosis when histopathology is equivocal (20). Phosphorus elevation in psoriatic epidermis has been demonstrated in multiple studies (21–24). This increase may reflect keratinocyte hyperproliferation, phosphorylation-dependent inflammatory signaling such as JAK-STAT (15), altered sphingolipid metabolism (16), and enhanced angiogenesis (17).

In collaboration with Jeff Burnham, I previously demonstrated elevated phosphorus in psoriatic skin using energy-dispersive x-ray (EDAX) microanalysis (21). EDAX allows elemental assessment beginning with beryllium and provides both quantitation and localization of elements within tissue (18). Grundin et al. similarly reported increased phosphorus across multiple epidermal strata in psoriatic skin compared with uninvolved skin (22). Additional studies using phosphorus-31 magnetic resonance spectroscopy (23) and thin-layer chromatography (24) have corroborated these findings. However, spectroscopy equipment is rarely available in clinical settings (19), and unlike EDAX, it lacks anatomical resolution and provides primarily biochemical data (25). Thin-layer chromatography is largely qualitative (24).

Current methods for evaluating psoriasis treatment efficacy remain limited in precision, reproducibility, and objectivity. Clinical scoring tools such as PASI, BSA, and PGA are inherently subjective and demonstrate inter-observer variability, making them less reliable for detecting early or subtle therapeutic changes. Cytokine profiling, genetic markers, and imaging-based assessments provide biologic insight but are costly, not widely accessible, and often lack direct correlation with real-time epidermal metabolic activity. Furthermore, these methods do not quantify elemental or biochemical alterations within lesional skin, leaving a gap in objective measurement of keratinocyte proliferation and inflammatory signaling.

EDAX quantitation offers a unique opportunity to directly measure elemental phosphorus within psoriatic tissue, providing a biochemical readout of disease activity that is not dependent on visual assessment or subjective scoring. Because phosphorus elevation reflects increased ATP turnover, heightened phosphorylation signaling, and accelerated keratinocyte proliferation, EDAX could serve as a sensitive indicator of treatment response—detecting improvement before clinical changes become visible. As an objective, quantifiable metric, EDAX may allow clinicians to more accurately monitor therapeutic efficacy, optimize treatment regimens, and identify non-responders earlier in the course of care. Incorporating EDAX-based phosphorus measurement into clinical evaluation could improve outcomes by enabling more precise, individualized, and timely adjustments in psoriasis management.

Thus, EDAX may represent a preferred instrument for sensitive monitoring of psoriasis activity in clinical studies. In summary, EDAX quantitates and localizes phosphorus within tissue and could serve as an objective biomarker for psoriatic activity and treatment response. At present, EDAX has not been incorporated into routine medical practice (26). Demonstrating its clinical utility will require further investigation.

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