

Nicotinamide Mononucleotide Application in Cosmetics Products with Potential Excellent Efficacy

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Introduction:

Nicotinamide mononucleotide (NMN) is an important precursor for the synthesis of nicotinamide adenine dinucleotide (NAD+) in the human body, which can be converted into NAD+ to exert various physiological functions. In humans, abnormalities in the process of NAD+ metabolism will cause the production of various aging-related diseases. NAD+ plays an important role in various biological processes such as cell death, aging, gene expression, neuroinflammation, and DNA repair^[1]. Therefore, NAD+ has now become an important target for anti-aging and related diseases. NMN is an intermediate product of NAD+ biosynthesis, one of the key precursors of NAD+^[2], and the most direct route to NAD+ synthesis^[3]. At present, the application research of NMN is mainly focused on medical drugs and health food, for example, in the field of medical drugs, it could alleviate and improve ischemic brain injury, such as Alzheimer's disease (AD)^[4], while the application in cosmetics products is nearly blank. This research will focus on the application of NMN in cosmetics, investigate the safety of NMN in cosmetics, and explore the stability of NMN and application formulations containing NMN ingredient, further study the efficacy of NMN by *in vivo* and *in vitro* experiments. In short, we try to explore the feasibility and efficacy of NMN in the field of cosmetics.

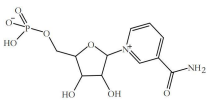


Figure 1 the structure of the nicotinamide mononucleotide (NMN)

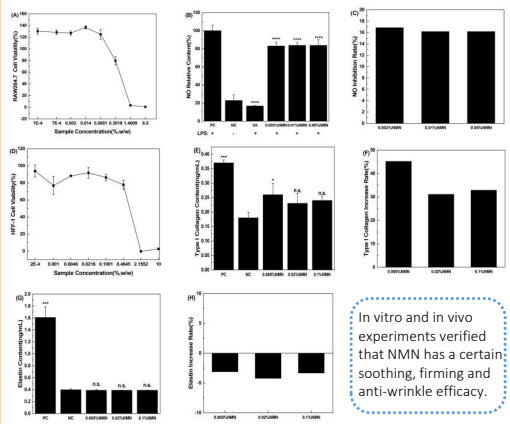
Results & Discussion:

Table 1 CAM test results. Six parallel experiments were performed for each sample. ES was the mathematical sum of the score of 6 chicken embryos, ES≤12: no/light eye irritation; 12<ES≤16: medium eye irritation; ES≥16: strong eye irritation

Sample	Test Results
The aqueous solution of 1% NMN	Not eye irritation (ES=1)
The simple basic skin care formula containing 1% NMN	Not eye irritation (ES=4)

The results of CAM test and patch test including 31 volunteers indicating that NMN was safety enough to used in cosmetics products.

NMN had poor stability at high temperature, while relatively stable under other test conditions. After being placed at 45°C the degradation rate was 72.67% and 95.7% respectively for 0.5 and 1 month.



In vitro and *in vivo* experiments verified that NMN has a certain soothing, firming and anti-wrinkle efficacy.

Figure 2 The results of *in-vitro* cell culture experiments, including toxicity detection, inflammatory factor NO inhibition test (decreasing 16.86%), and promoting Pro-collagen synthesis test (increasing 45.19% for type I collagen).

Materials & Methods:

Type of test	Concentrations of NMN	Method or Model	Evaluation Parameters	
Safety Test	1%	Chick Chorioallantoic Membrane (CAM) test	Toxic effects	
		Human Patch test	Skin reaction	
Stability Test	0.15%, 1%	45°C, sunlight, 5°C, room temperature, high-low temperature cycle, and -15°C	The content of NMN	
In vitro cell experiments	NO inhibition test	0.003%, 0.01%, 0.05%	Lipopolysaccharide(LPS)-induced mouse mononuclear macrophages(RAW264.7)	The content of nitric oxide(NO)
	up-regulated rate of type I collagen content	0.005%, 0.02%, 0.1%	UVB-induced fibroblasts(HFF-1 cell)	The content of type I collagen
	up-regulated rate of elastin content	0.005%, 0.02%, 0.1%	UVB-induced fibroblasts(HFF-1 cell)	The content of elastin
In vivo efficacy test	1%	Single-blind test and Controlled experiment, 34 healthy Chinese volunteers twice a day and lasted for 28 days	Wrinkle length, moisture, and rebound time	

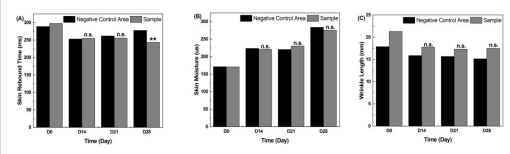


Figure 3 The results of the volunteers' efficacy tests, the test parameters including rebound time, moisture and wrinkle length. Of these only skin rebound time showed a significant improvement (18.14%, P<0.01).

Conclusions:

In this study, in the field of cosmetics application NMN has good soothing, anti-wrinkle, and firming efficacy, and it is also safety enough. At the same time, NMN has good water solubility and could be applied to various formulation systems. Further efforts are needed to solve the problem of stability under high temperature and transdermal absorption on the skin. Combining the performance of NMN, it is expected to become a compelling raw material in functional cosmetics.

References:

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