

Joint Mobility Solution

WHITE PAPER

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1.Global Trends in Bone & Joint Health and Proactive Health Management

Shifts in modern lifestyles and demographic structures have sparked a global bone and joint health crisis. Sedentary office routines, sports injuries, coupled with accelerated population aging, have rendered degenerative joint disorders a critical public health concern that undermines people's quality of life.

Traditional wellness philosophies have long advocated bone and joint care to sustain the normal functionality of the human musculoskeletal system. Multi-path synergistic bone and joint support solutions, featuring a four-dimensional efficacy framework of cartilage repair, joint lubrication, bone fortification and anti-inflammation, precisely address the urgent demand for bone-joint health among modern consumers and are emerging as a central focus across the wellness sector.

Data published by The Business Research Company indicates that the global bone and joint supplement market was valued at an estimated USD 14.99 billion in 2025, with a projected market size of USD 24.12 billion by 2030, representing a compound annual growth rate (CAGR) of 9.8% over the forecast period. The Asia-Pacific region demonstrates robust growth momentum, which mirrors the deep-rooted recognition of the Eastern wellness principle that advocates equal attention to both tendons and bones.

Undoubtedly, bone and joint health represents a pivotal market segment that addresses the dual challenges of modern exercise-related strain and population aging, propelling the health consumption market into a new era centered on proactive maintenance and systematic tissue repair.

2.NF TriSolve®: A Scientifically Designed Bone & Joint Protection Solution

2.1 Multi-pathway · Synergistic Repair · Scientifically Validated

Guided by the formulation design principle of "Four-Dimensional Synergy", NF TriSolve® Joint Flex Complex selects five core active ingredients, which target four major pathways respectively: cartilage structure, joint lubrication, bone metabolism and anti-inflammatory repair. Scientific blending of these ingredients delivers synergistically enhanced efficacy.

Table 1 Formulation Concept

Ingredient	Action Pathway	Core Efficacy	Ingredient	Action Pathway	Core Efficacy
Glucosamine				Cartilage Structural Support	
Chondroitin Sulfate				Joint Lubrication & Buffering	
Calcium AKG				Bone Metabolism + Energy Supply	
Vitamin D3				Calcium Absorption Regulation	
Rare Ginsenosides				Anti-Inflammation & Repair	

2.2 Patent Ingredient×Patented Formula×One-Fifth the Dose×Superior Results

Under the experimental conditions specified herein, NF TriSolve® JointFlex Complex

exhibits prominent dose-response efficiency. Compared with chondroitin sulfate A sodium salt used as the positive control, NF TriSolve® was tested at only 22.8% of its dosage, yet delivered approximately 2.0 times the relative efficacy in cartilage injury repair assessments and 2.3 times the relative efficacy in mobility-related evaluations.

Against commercially available compound bone and joint products, NF TriSolve® was administered at merely 19.6% of their test dosage, while achieving around 1.3 times the efficacy for cartilage damage repair and 1.6 times the efficacy in mobility improvement.

The above findings demonstrate that under the present experimental model and test parameters, the synergy of patented raw materials and scientific formulation enables NF TriSolve® JointFlex Complex to deliver superior efficacy output per unit dosage.

Table 2 Comparison with Positive Control (Chondroitin Sulfate A Sodium Salt)

Evaluation Index	Positive Control (Chondroitin Sulfate A Sodium Salt)	NF TriSolve® JointFlex Complex	Advantage
Dosage	1000mg	228mg	Only 22.8% of the control dosage
Cartilage Damage Repair	1.0x	2.0x	100% efficacy improvement
Mobility Recovery	1.0x	2.3x	130% efficacy improvement

Table 3 Comparison with Commercial Glucosamine Compound Products

Evaluation Index	Commercial Glucosamine Compound Products	NF TriSolve® JointFlex Complex	Advantage
Dosage	1165mg	228mg	Only 19.6% of the reference dosage
Cartilage Damage Repair	1.0x	1.3x	30% efficacy improvement

Evaluation Index	Commercial Glucosamine Compound Products	NF TriSolve® JointFlex Complex	Advantage
Mobility Recovery	1.0x	1.6x	60% efficacy improvement

3. Zebrafish Model Test

3.1 NF TriSolve® Cartilage Repair(Phenotype)

Imaging results provide intuitive visual evidence: the normal control group exhibited robust cartilage fluorescence signals with intact morphological contours; the model control group showed markedly attenuated fluorescence intensity accompanied by atrophic cartilage morphology. Among them, the NF TriSolve® test group achieved remarkably superior repair effects, with cartilage morphology and fluorescence intensity nearly comparable to those of the normal control group.

Higher cartilage fluorescence intensity reflects better cartilage repair effect.

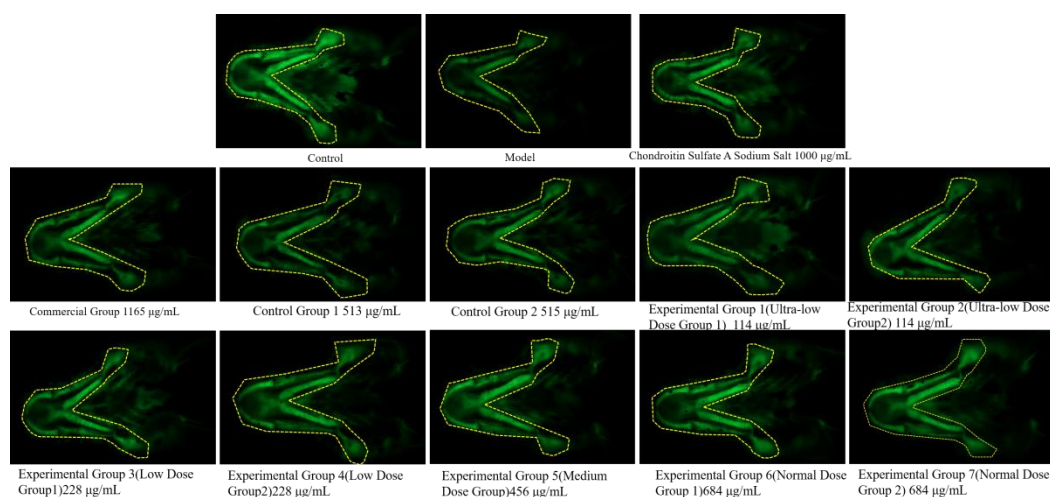


Figure 1 Representative images of cartilage fluorescence intensity in zebrafish after sample treatment

Note:The yellow dashed box marks the analysis area.

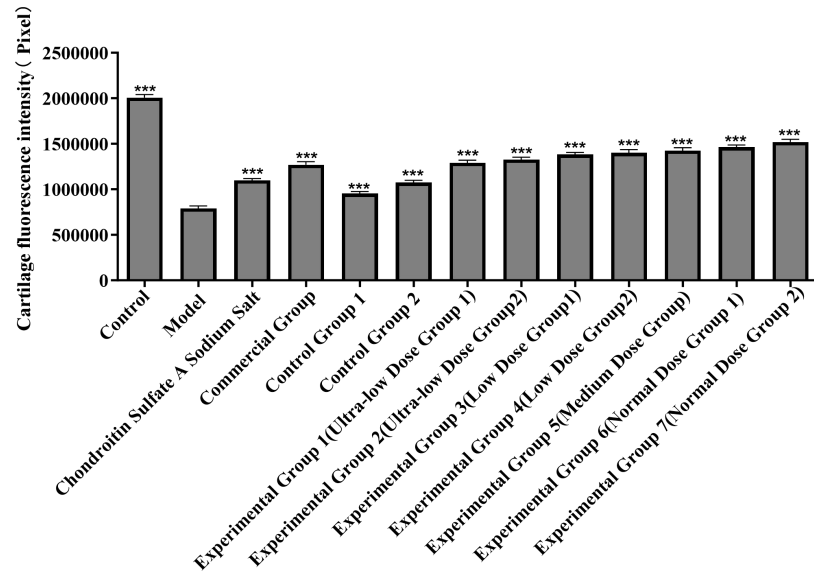


Figure 2 Cartilage fluorescence intensity

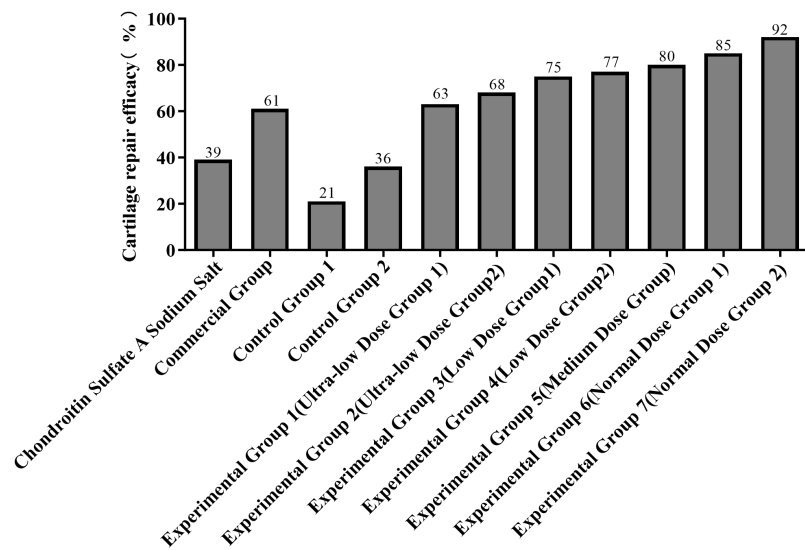


Figure 3 Bar chart of cartilage fluorescence intensity

Groups 1 to 7 in the experimental set all exhibit cartilage injury repair efficacy, manifested as elevated cartilage fluorescence intensity

3.2 Cartilage Injury Repair Efficacy of NF TriSolve®(Behavioral Assay)

NF TriSolve® JointFlex Complex shows definite and significant efficacy in repairing cartilage tissue injury.

The total moving distance increased significantly, confirming functional recovery.

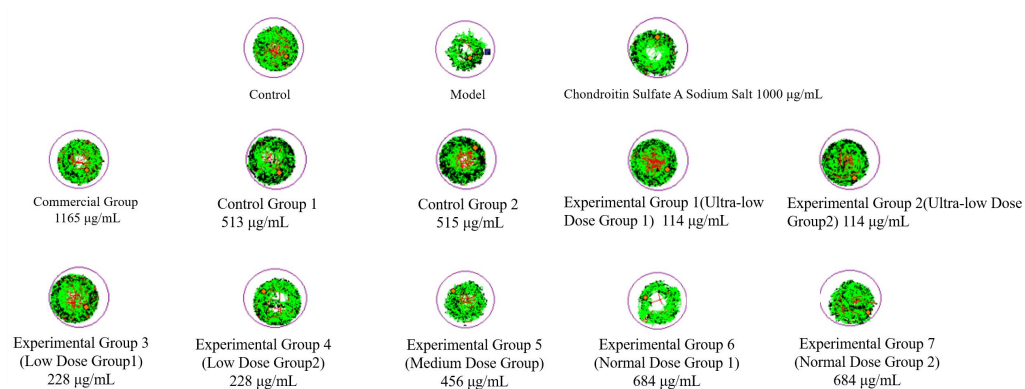


Figure 4 Representative locomotion trajectory plots of zebrafish after sample treatment

Note: Black lines indicate low-speed movement distance; green lines indicate medium-speed movement distance; red lines indicate high-speed movement distance.

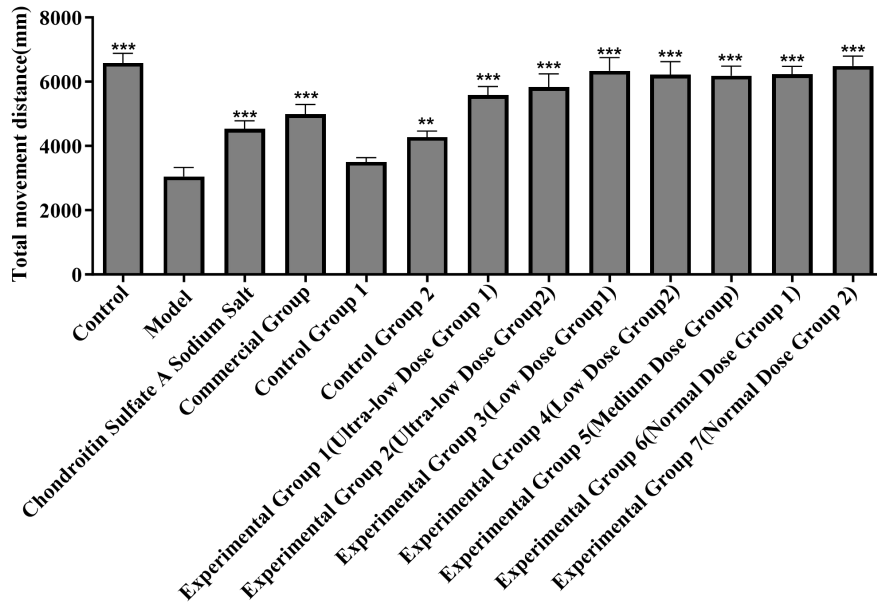


Figure 5 Total movement distance, ***p < 0.001

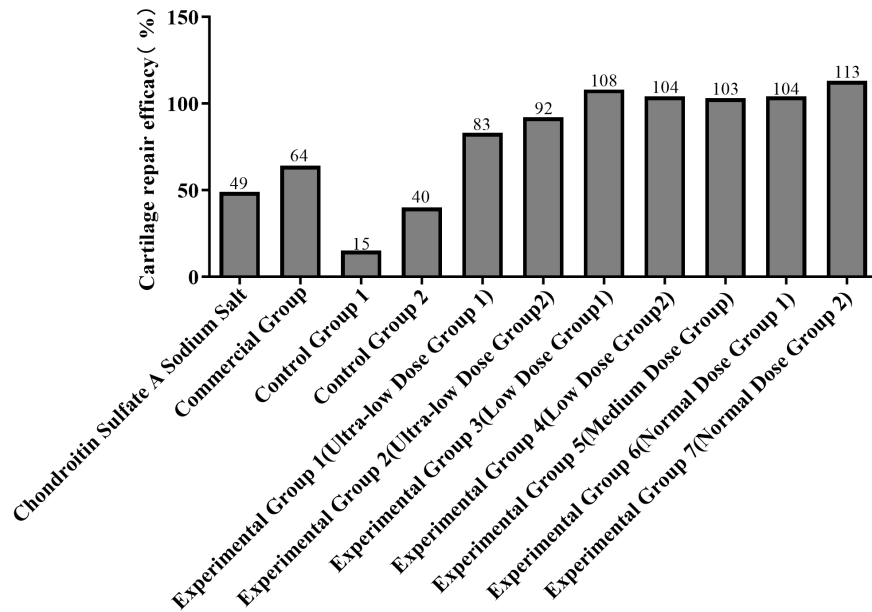


Figure 7 Cartilage repair efficacy, ***p < 0.001

Experimental Groups 1–7 all demonstrate cartilage injury repair effects, evidenced by an increase in total travel distance.

4. Formula Screening and Optimization:

4.1 From Seven Formulas to the Preferred Scheme

Systematically validated via zebrafish models, NF TriSolve® delivers outstanding synergistic effects across five key dimensions: anti-aging, collagen boosting, elastin promotion, skin brightening, and hydration & moisture retention.

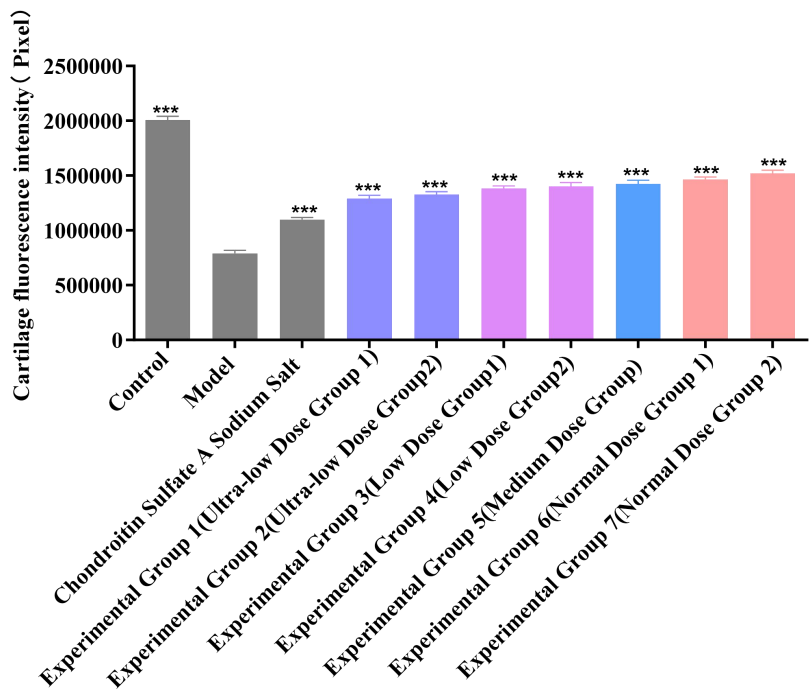


Figure 8 Cartilage fluorescence intensity

Compared with the model control group, *p < 0.001.

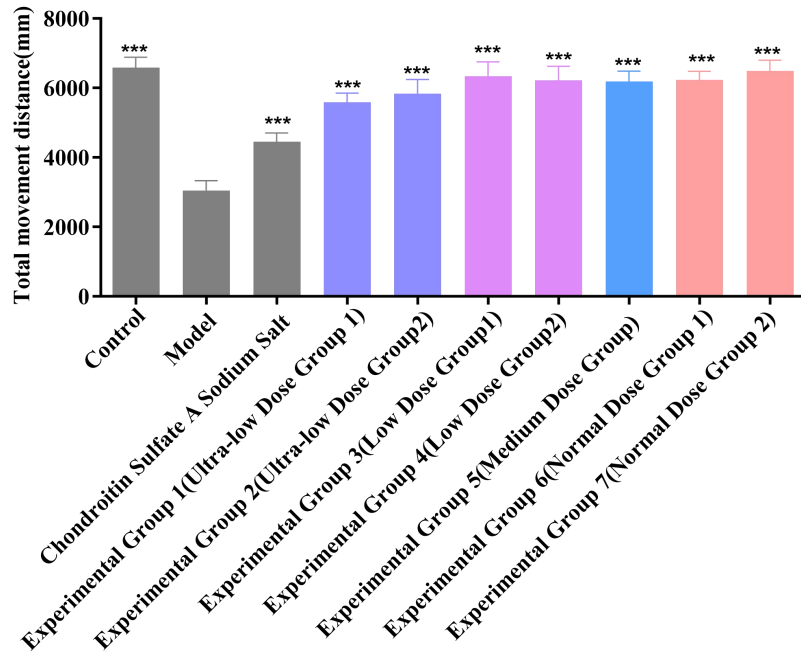


Figure 9 Total movement distance

Compared with the model control group, * $p < 0.001$.

4.2 Scientific proportioning determines synergistic efficiency

The effect of synergistic design is not a simple additive sum. The bioactivity value generated by scientific formulation far exceeds the simple stacking of individual ingredients, achieving a profound efficacy leap where $1+1>2$.

Cartilage Injury Repair Rate: TriSolve® = 77%, Positive Control = 39%

Mobility Recovery Rate: TriSolve® = 104%, Positive Control = 46%

5. Market Competitiveness

5.1 TriSolve® JointFlex Complex versus International Benchmark Products

From anti-aging and bone-joint care to broader wellness categories, we deliver

solutions powered by targeted delivery technology, engineered via systematic formulation design, and validated by a complete chain of efficacy evidence.

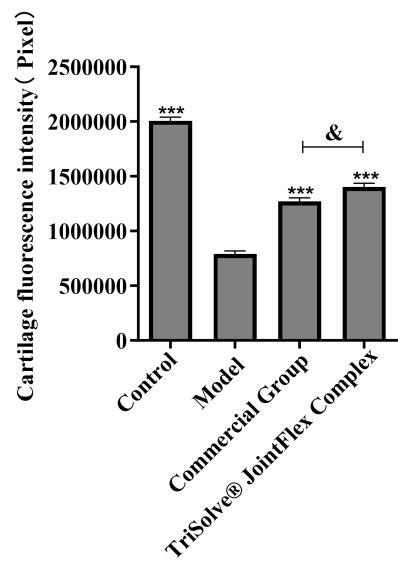


Figure 8 Cartilage fluorescence intensity

Compared with the model control group, *** $p < 0.001$; compared with the commercial group, & $p < 0.05$

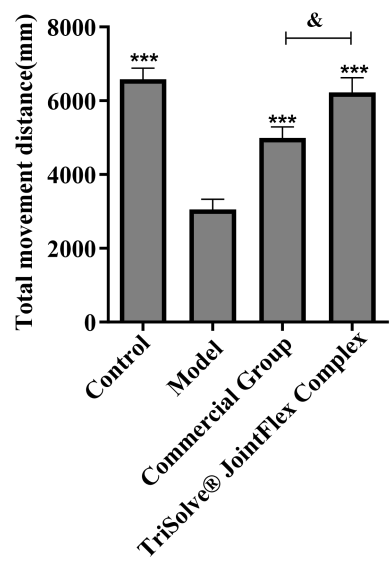


Figure 9 Total movement distance

Compared with the model control group, *** $p < 0.001$; compared with the

commercial group, & $p < 0.05$

5.2 NF TriSolve® Functional Ingredient Delivery Platform

Solutions powered by delivery technology, systematically engineered and validated with a full chain of efficacy evidence — spanning anti-aging, bone & joint health, and an expansive spectrum of wellness applications.

Table 4 Demonstration of Two Formulation Solutions

Method 1	Method 2
NF TriSolve® MitoAge Complex	NF TriSolve® JointFlex Complex
Oral Anti-Aging Solution	Joint and Bone Protection Solution
Validated efficacy data across five dimensions	Validated via zebrafish cartilage repair model
Synergistic effect exceeding 97%	Cartilage repair efficacy reaches 50%, nearly twice that of the positive control group
Overall superiority against competing products	Functional recovery efficacy hits 90% relative to the normal control group

6. Annex

6.1 Evaluation of Cartilage Injury Repair Efficacy (Phenotype)

Transgenic zebrafish with green fluorescent cartilage at 2 days post fertilization (2 dpf) were randomly selected and placed in 6-well plates, with 30 zebrafish per well for each experimental group. Samples were administered via aqueous solution at concentrations listed in Table 1-1, and chondroitin sulfate A sodium salt at 1000 μ g/mL was used as the positive control. A normal control group and a model control group were also established, with a liquid volume of 3 mL per well. Except for the

normal control group, all other groups were treated with dexamethasone in aqueous solution to establish the zebrafish cartilage injury model. After incubation at 28°C for 3 days, 10 zebrafish were randomly selected from each group and imaged under a fluorescence microscope. Data acquisition and analysis were performed using NIS-Elements D 3.20 advanced image processing software to determine cartilage fluorescence intensity (A). The repair efficacy of samples against cartilage injury was evaluated based on the statistical results of this indicator. All data were expressed as mean $\pm$ SE. The calculation formula for cartilage injury repair efficacy is as follows:

$$\text{Cartilage injury repair efficacy (\%)} = \frac{A(\text{Sample Group}) - A(\text{Model Group})}{A(\text{Model Group})} \times 100\%$$

Statistical analysis was performed using SPSS software. A difference with $p < 0.05$ was considered statistically significant.

6.2 Evaluation of Cartilage Injury Repair Efficacy (Behavior)

Wild-type AB strain zebrafish at 2 dpf were randomly selected and distributed into 6-well plates, with 30 fish per well for each experimental group. Samples were administered via aqueous solution at concentrations shown in Table 1-2. A normal control group and a model control group were set up, and each well contained 3 mL of solution. All groups except the normal control group were treated with dexamethasone in aqueous solution to establish the zebrafish cartilage injury model. After incubation at 28°C for 3 days, 10 zebrafish were randomly selected from each group and transferred to 96-well plates. The total movement distance (B) of zebrafish was measured using a behavior analyzer. The cartilage injury repair efficacy of samples was evaluated based on statistical analysis of this index. All data were expressed as mean $\pm$ SE. The calculation formula for cartilage injury repair efficacy is as follows:

$$\text{Cartilage injury repair efficacy (\%)} = \frac{B(\text{Sample Group}) - B(\text{Model Group})}{B(\text{Model Group})} \times 100\%$$

Statistical analysis was performed using SPSS software. A difference with $p < 0.05$ was considered statistically significant.

7.Disclaimer

The content of this white paper is intended solely for industry exchange and general information purposes; it does not constitute medical advice, diagnosis, or treatment recommendations. Individuals suffering from bone or joint disorders should seek care at qualified medical institutions and follow professional medical advice. Cited research data and conclusions are based on existing scientific evidence and do not imply any guarantee regarding the efficacy of specific products. Actual product results may vary due to factors such as individual differences and usage methods. Information regarding the regulatory status of ingredients is based on regulations in effect at the time of writing; as regulations are subject to change, please refer to the latest requirements from local regulatory authorities for specific compliance details. This white paper is the property of NATURAL FIELD CO., LTD.; unauthorized reproduction, redistribution, or commercial use is strictly prohibited.

8.Acknowledgments

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