International Journal of Environmental & Agriculture Research (IJOEAR)
ISSN: [2454-1850]
[Vol-12, Issue-7, July- 2026]
Website: www.ijoear.com
Journal DOI: 10.25125/agriculture-journal

Mogrosides as Natural High-Intensity Sweeteners: Chemistry, Bioactivity and Applications in Functional Foods

Doda Srujana[1*]; Afifa Jahan[2]; K. Aparna[3]; Vijaya Kumar. A[4]

[*1]Master's student, Department of Foods and Nutrition, Post Graduate and Research Centre, PJT Agricultural University, Rajendranagar, Hyderabad - 500030, Telangana, India.
[2]Assistant Professor, Department of Foods and Nutrition, College of Community Science, Saifabad, Hyderabad - 500004, Telangana, India.
[3]Principal Scientist, MFPI-Quality Control Laboratory, P.J.T. Agricultural University, Rajendranagar, Hyderabad - 500030, Telangana, India.
[4]Associate Professor, Department of Veterinary Public Health and Epidemiology, College of Veterinary Science, Mamnoor, Warangal, 506166, Telangana, India
*Corresponding Author

Received:- 27 June 2026/ Revised:- 08 July 2026/ Accepted:- 17 July 2026/ Published: 31-07-2026

***Abstract*—** *Mogrosides are a group of cucurbitane-type triterpenoid glycosides extracted from monk fruit (*Siraitia grosvenorii*) and are widely recognized for their intense sweetness and health-promoting properties. Among them, mogroside V is the primary bioactive compound responsible for sweetness, exhibiting approximately 150–300 times the sweetness of sucrose without caloric contribution. In recent years, mogrosides have gained considerable attention due to their multifunctional biological activities, including antioxidant, anti-inflammatory, anti-diabetic, and neuroprotective effects. Additionally, their stability under various processing conditions makes them suitable for application in functional foods and nutraceuticals. This review provides a comprehensive overview of the chemistry, biosynthesis, functional properties, and industrial applications of mogrosides, along with recent advances in their extraction, safety evaluation, and future research directions.*

Keywords*— *Mogrosides, Natural sweeteners, Monk fruit, Glycosyltransferases, Anti-inflammatory, Anti-diabetic, Nutraceuticals, Functional foods.

I. INTRODUCTION

The increasing global prevalence of metabolic disorders such as obesity and diabetes has intensified the demand for natural, low-calorie sweeteners. Conventional sugars contribute significantly to calorie intake, leading to adverse health outcomes. As a result, natural sweeteners derived from plants have gained considerable interest. Mogrosides, isolated from monk fruit (*Siraitia grosvenorii*), represent a promising alternative due to their high sweetness intensity and negligible calorie value.

Historically, monk fruit has been used in traditional Chinese medicine for treating respiratory ailments such as cough and sore throat. However, recent advancements in food science and pharmacology have expanded its applications beyond traditional uses. Mogrosides have been identified as the key compounds responsible for the sweetness and biological activity of monk fruit. Their potential role in functional foods and nutraceuticals has been extensively explored in recent years.

Recent studies indicate that mogroside V exhibits significant pharmacological effects, including antioxidant and anti-inflammatory activities, as well as regulation of glucose metabolism through pathways such as AMPK signaling. These properties make mogrosides highly relevant in modern dietary and therapeutic applications (Zhang et al., 2025).

II. CHEMICAL STRUCTURE AND CLASSIFICATION

2.1 Structural Characteristics:

Mogrosides are cucurbitane-type triterpenoid glycosides composed of a hydrophobic aglycone (mogrol) linked to multiple glucose units. The degree of glycosylation significantly influences sweetness intensity and functional properties. Among the identified compounds (mogroside I–V), mogroside V (M5) is the most abundant and sweetest constituent. Typically, mogroside V is present in monk fruit at concentrations ranging from 0.45% to 0.87% (dry weight basis), depending on maturity and processing conditions (He et al., 2025).

The sweetness of mogrosides is directly related to the number and arrangement of glucose residues. Structural studies have demonstrated that increased glycosylation enhances sweetness intensity, with some mogrosides exhibiting sweetness levels up to 400 times that of sucrose (Cui et al., 2024). However, mogroside V typically exhibits sweetness approximately 150–300 times that of sucrose.

2.2 Classification

Mogrosides are classified into several types, including mogroside I, II, III, IV, and V. Among these, mogroside V is the predominant compound responsible for sweetness and biological activity. Recent analytical studies have identified more than 80 different mogroside variants in monk fruit, highlighting the structural diversity of these compounds (Pei et al., 2025).

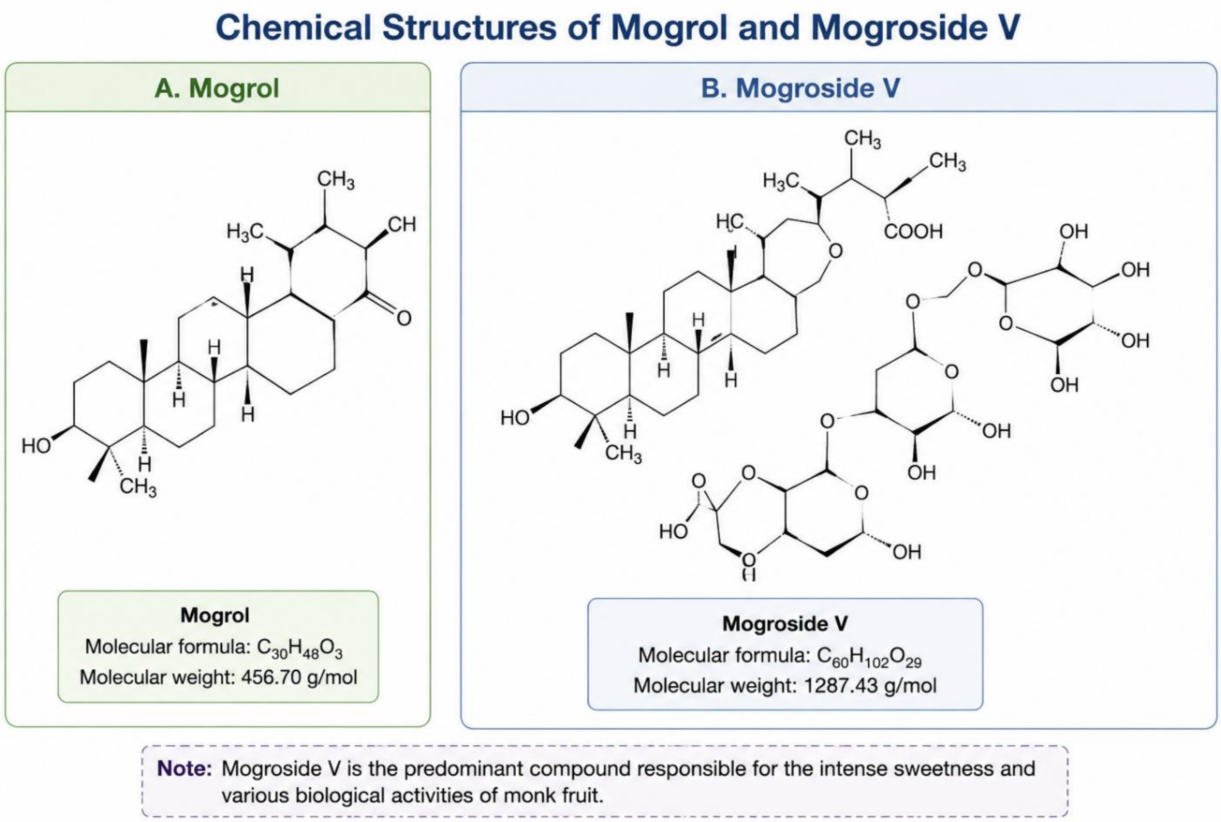

FIGURE 1: The chemical structure of mogrol and mogroside

TABLE 1
CLASSIFICATION AND PROPERTIES OF MAJOR MOGROSIDES IN MONK FRUIT (*SIRAITIA GROSVENORII*)

Mogroside Type	Sugar Units (Glucose Residues)	Sweetness Intensity (Relative to Sucrose)	Approximate Abundance in Monk Fruit	Key Characteristics	References
Mogroside I	1–2	Low (minimally sweet)	Trace amounts	Minor component; limited sweetness; precursor to more glycosylated forms	Pei et al., 2025
Mogroside II	2–3	Low to moderate	Low	Intermediate in biosynthesis; limited commercial use	Pei et al., 2025
Mogroside III	3–4	Moderate	Low to moderate	Intermediate sweetness; less stable than higher glycosylated forms	Pei et al., 2025
Mogroside IV	4–5	High	Moderate	Significant sweetness; precursor to mogroside V	Pei et al., 2025
Mogroside V	5–6	150–300×	0.45–0.87% (dry weight)	Primary bioactive and sweetest compound; responsible for most biological activities; highest commercial value	He et al., 2025; Cui et al., 2024
Mogroside VI	6+	Up to 400×	Trace amounts	Highest sweetness potential; rare; limited commercial application	Cui et al., 2024

III. BIOSYNTHESIS OF MOGROSIDES

The biosynthesis of mogrosides involves multiple enzymatic steps, including cyclization, oxidation, and glycosylation. Glycosyltransferases play a crucial role in attaching glucose units to the mogrol backbone. Recent advances in synthetic biology have enabled the engineering of glycosyltransferases to improve mogroside production efficiency. For example, engineered enzymes have been shown to enhance the conversion of mogrol to mogroside V, increasing yield and reducing production costs (Zhao et al., 2025). Understanding the biosynthesis pathway is essential for developing sustainable production methods, particularly given the limited availability of monk fruit.

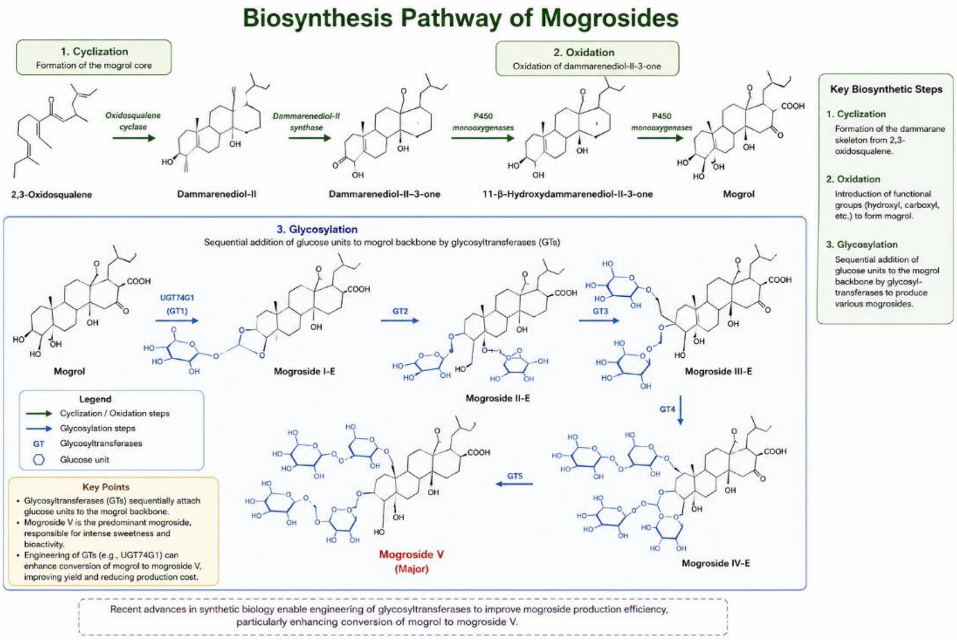

FIGURE 2: The Biosynthesis Pathway of Mogrosides

IV. PHYSICOCHEMICAL PROPERTIES

Mogrosides exhibit several desirable physicochemical properties that make them suitable for food applications:

- **High sweetness intensity:** 150–300 times sweeter than sucrose
- **Thermal stability:** Suitable for baking and heat processing
- **pH stability:** Maintains functionality across a wide pH range
- **Water solubility:** Easily incorporated into beverages and liquid formulations

These properties enable their use in various food systems, including beverages, baked foods, and dairy alternatives.

TABLE 2
PHYSICOCHEMICAL PROPERTIES OF MOGROSIDES FOR FOOD APPLICATIONS

Property	Description	Significance for Food Applications
Sweetness Intensity	150–300× sweeter than sucrose (mogroside V)	Low-calorie sweetening; reduced sugar content in foods
Caloric Value	Negligible (non-caloric)	Suitable for weight management and diabetic diets
Thermal Stability	Stable at high temperatures (baking, pasteurization)	Suitable for baked goods and heat-processed foods
pH Stability	Maintains functionality across wide pH range (2–10)	Suitable for acidic beverages and various food systems
Water Solubility	Highly soluble in water	Easily incorporated into beverages and liquid formulations
Sensory Profile	Slight bitter or licorice-like aftertaste	May require flavor masking in some applications
Storage Stability	Stable under normal storage conditions	Long shelf life; suitable for commercial products

V. BIOLOGICAL ACTIVITIES AND HEALTH BENEFITS

5.1 Antioxidant Activity

Mogrosides exhibit strong antioxidant activity by scavenging reactive oxygen species (ROS) and enhancing cellular defense mechanisms. This activity helps reduce oxidative stress and prevents cellular damage. Studies have shown that mogroside V enhances mitochondrial function and promotes cellular homeostasis (Zhang et al., 2025).

5.2 Anti-inflammatory Effects

Mogrosides modulate inflammatory pathways by reducing pro-inflammatory cytokines and inhibiting key signaling pathways. These effects contribute to their potential therapeutic applications in chronic inflammatory diseases (Zhang et al., 2025).

5.3 Anti-diabetic and Anti-obesity Potential

Mogrosides regulate glucose and lipid metabolism through pathways such as AMPK and PI3K/Akt, contributing to improved insulin sensitivity and reduced adipogenesis (He et al., 2025).

5.4 Neuroprotective Effects

Recent studies indicate that mogroside V may provide neuroprotection by regulating oxidative stress and metabolic pathways, particularly in neurodegenerative conditions such as Parkinson's disease (Tang et al., 2024).

5.5 Gastrointestinal Protective Effects

Mogroside-rich extracts have been shown to reduce intestinal damage and inflammation under stress conditions, highlighting their protective role in gut health (Lu et al., 2023).

5.6 Antiviral and Other Biological Effects

Mogroside V has demonstrated antiviral activity in vitro, indicating its potential role in immune modulation and disease prevention (Liang et al., 2025).

TABLE 3
SUMMARY OF BIOLOGICAL ACTIVITIES OF MOGROSIDES AND THEIR MECHANISMS OF ACTION

Biological Activity	Key Compound	Mechanism of Action	Health Implication	References
Antioxidant	Mogroside V	Scavenges ROS; enhances mitochondrial function; promotes cellular homeostasis	Reduces oxidative stress; prevents cellular damage	Zhang et al., 2025
Anti-inflammatory	Mogroside V	Reduces pro-inflammatory cytokines; inhibits key inflammatory signaling pathways	Potential therapeutic applications in chronic inflammatory diseases	Zhang et al., 2025
Anti-diabetic	Mogroside V	Regulates glucose metabolism via AMPK and PI3K/Akt pathways; improves insulin sensitivity	Management of type 2 diabetes; blood glucose control	He et al., 2025
Anti-obesity	Mogroside V	Reduces adipogenesis; regulates lipid metabolism	Weight management; prevention of obesity-related disorders	He et al., 2025
Neuroprotective	Mogroside V	Regulates oxidative stress and metabolic pathways	Potential therapeutic role in Parkinson's disease and other neurodegenerative conditions	Tang et al., 2024
Gastrointestinal Protective	Mogroside-rich extract	Reduces intestinal damage and inflammation under stress conditions	Gut health protection; reduces stress-induced intestinal damage	Lu et al., 2023
Antiviral	Mogroside V	Inhibits viral replication (in vitro)	Immune modulation; potential antiviral therapeutic applications	Liang et al., 2025

VI. EXTRACTION AND PROCESSING

Mogrosides are typically extracted using water or ethanol extraction methods, followed by purification and drying. The extraction process involves:

1. Crushing of monk fruit
2. Solvent extraction
3. Filtration and purification
4. Concentration
5. Drying

Recent advancements in extraction technologies aim to improve yield and purity while reducing costs. Emerging techniques such as ultrasound-assisted extraction, microwave-assisted extraction, and enzyme-assisted extraction have shown promise for enhancing mogroside recovery.

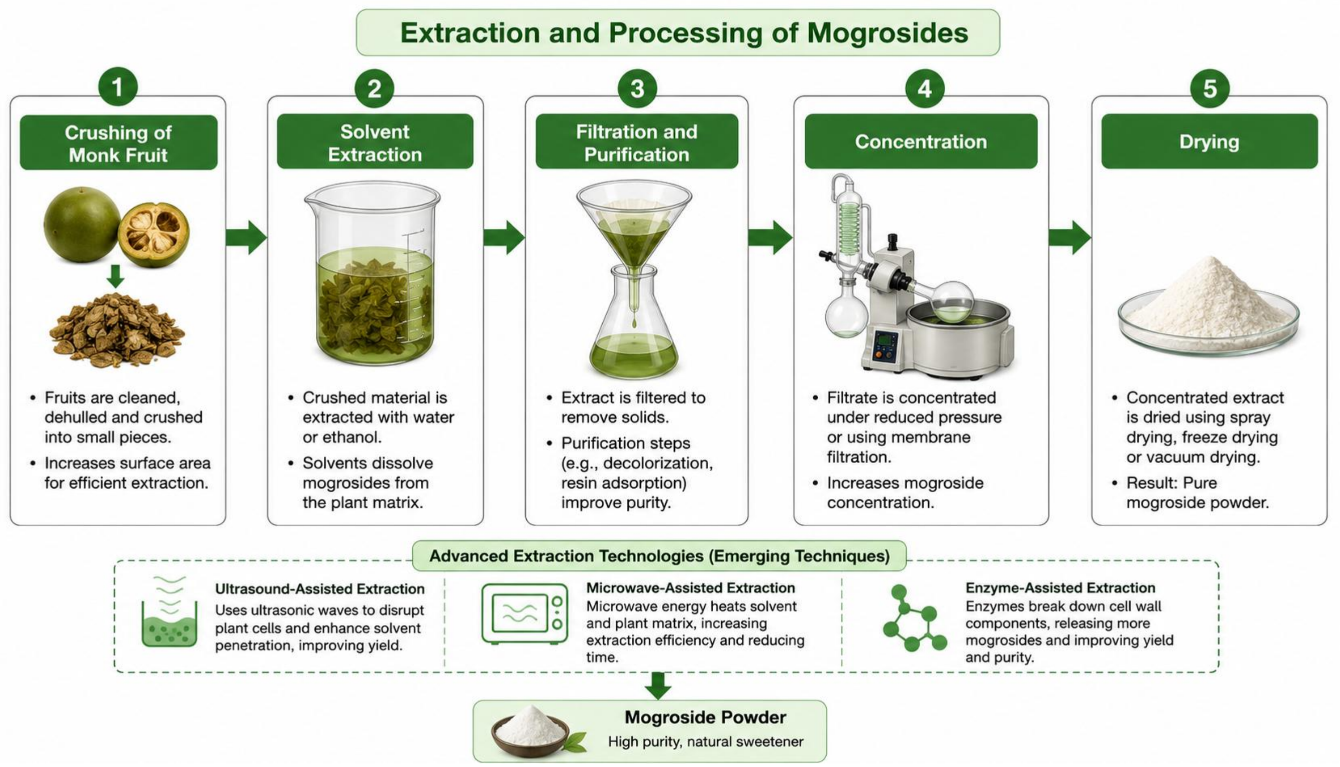

FIGURE 3: The Extraction and Processing Flow Diagram

VII. APPLICATIONS IN FOOD AND NUTRACEUTICAL INDUSTRIES

7.1 Functional Foods and Beverages

Mogrosides are widely used in low-calorie beverages, herbal teas, and functional drinks. Their natural origin and health benefits make them suitable for clean-label products.

7.2 Dairy and Plant-Based Products

Mogrosides are increasingly incorporated into yogurt and plant-based alternatives to enhance sweetness without adding calories.

7.3 Nutraceuticals and Pharmaceuticals

Due to their biological activities, mogrosides are used in dietary supplements and therapeutic formulations. Additionally, monk fruit extracts have been recognized as Generally Recognized as Safe (GRAS) ingredients, further supporting their commercial use (Zhang et al., 2025).

VIII. LIMITATIONS AND SAFETY CONSIDERATIONS

Despite their benefits, mogrosides present certain challenges:

- Slight bitter or licorice-like aftertaste
- High extraction and production costs
- Limited large-scale cultivation

Recent studies also suggest that excessive exposure may influence intestinal epithelial function, indicating the need for further safety evaluation (Shil et al., 2025).

IX. FUTURE PERSPECTIVES

Future research should focus on:

- Improving extraction and purification techniques
- Enhancing bioavailability and sensory properties
- Expanding applications in functional and plant-based foods
- Conducting long-term clinical studies to confirm safety and efficacy
- Developing cost-effective production methods through biotechnology
- Exploring synergistic effects with other natural compounds

Advancements in biotechnology and enzymatic synthesis may further enhance the commercial viability of mogrosides.

X. CONCLUSION

Mogrosides, particularly mogroside V, represent a promising class of natural, high-intensity sweeteners with multifunctional health benefits. Their unique combination of sweetness, stability, and therapeutic potential makes them suitable for modern food and nutraceutical applications. Continued research and technological advancements are essential to overcome current limitations and fully exploit their industrial potential

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

[1] Cui, S., Zhang, S., Wang, N., Su, X., Luo, Z., Ma, X., & Li, M. (2024). Structural insights into the catalytic selectivity of glycosyltransferase SgUGT94-289-3 towards mogrosides. *Nature Communications*, *15*(1), 6423.

[2] He, Y. L., Hu, P., Xia, H. L., Gong, Y. X., Feng, W. T., Deng, L. R., & Zeng, Y. J. (2025). Mogroside V: Molecular mechanisms and therapeutic applications. *Phytomedicine*, Article 157250.

[3] Lu, R., Hu, J., Liu, X., Yu, L., Hu, J., Jiang, H., & Liang, X. (2023). Mogroside-rich extract from *Siraitia grosvenorii* fruits protects against heat stress-induced intestinal damage by ameliorating oxidative stress and inflammation in mice. *Food & Function*, *14*(2), 1238-1247.

[4] Pei, J., Su, Q., Jiang, S., Li, J., & Xie, N. (2025). Exploring the structural diversity and spatiotemporal dynamics of mogrosides in *Siraitia grosvenorii*. *Food Chemistry*, Article 146185.

[5] Shil, A., Amoakohene, O., & Chichger, H. (2025). The non-synthetic sweeteners, miraculin and mogroside V, but not stevia, disrupt the intestinal epithelial barrier function through a sweet taste receptor-dependent mechanism. *Scientific Reports*, *15*(1), 44861.

[6] Tang, Q., Qiu, R., Guo, M., Wang, L., Zhang, Y., Chen, Y., & Cheng, Y. (2024). Mogroside V and mogrol: Unveiling the neuroprotective and metabolic regulatory roles of *Siraitia grosvenorii* in Parkinson's disease. *Frontiers in Pharmacology*, *15*, 1413520.

[7] Zhang, T., Gao, Z., Zeng, D., & Wang, Y. (2025). Mogroside V: A review of its structure, synthesis, pharmacokinetics, and toxicity. *Archiv der Pharmazie*, *358*(10), e70112.

[8] Zhang, Z., Adiham, A., Han, C., Huang, F., Yan, Y., Li, D., & Gong, P. (2025). Mogroside V derived from *Siraitia grosvenorii* fruit: From evidence of health-promoting benefits to food applications. *Trends in Food Science & Technology*, *163*, 105141.

[9] Zhao, M., Lai, D., Jia, X., Yu, M., Liu, Z. Q., & Zheng, Y. G. (2025). UDP-glycosyltransferases engineering coupled with UDPG regeneration facilitate the efficient conversion of mogroside V. *Journal of Agricultural and Food Chemistry*, *73*(9), 5341-5352.