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GEOGRAPHICAL VARIATIONS IN MORINGA OLEIFERA AND ITS POTENTIAL FOR STUNTING INTERVENTION: A SYSTEMATIC REVIEW

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ABSTRACT
Stunting is a major global health issue, particularly in Indonesia, where malnutrition rates remain high. Poor childhood nutrition affects growth, cognition, and long-term health. Moringa oleifera is a nutrient-rich herbal supplement, but its nutritional composition varies by geography, potentially influencing its effectiveness in stunting interventions. Objective: To identify the best Moringa leaf source for extract production to support weight and height improvement in stunted children. Method: A systematic literature review (SLR) was conducted using Google Scholar, ScienceDirect, and PubMed (2014–2024). From 70 initially identified articles, 6 were selected using the PICOS method, focusing on Moringa supplementation, malnourished children, and growth outcomes. Results: Highland Moringa contains higher vitamin C and flavonoid levels, while lowland Moringa offers greater biomass for large-scale production. Studies confirm that dried Moringa extract significantly improves weight gain ($p = 0.002$), though its effects on height and inflammation reduction were less pronounced. Conclusion: Dried Moringa extract shows promise for weight gain and nutrition enhancement in stunted children. However, geographical factors influence its nutrient content, requiring further research to standardize formulations, optimize dosages, and assess long-term effects in human trials.

Keywords: height; moringa leaf extract; nutritional compounds; stunting; weight

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INTRODUCTION

Malnutrition remains a major global health challenge, particularly in developing countries like Indonesia, which has one of the highest rates of child malnutrition worldwide. Nutritional deficiencies occur not only in low-income populations but also in middle- and high-income societies, emphasizing the complexity of this issue. According to the World Health Organization (WHO), multiple factors contribute to stunting, including economic conditions, maternal education, exclusive breastfeeding practices, birth weight, and maternal height. UNICEF (2022) reported that one in ten children under five suffers from wasting, while three in ten experience stunting, making it a pressing issue in global child health (WHO, 2020; UNICEF Indonesia, 2022; Addae et al., 2024)Stunting is defined as impaired linear growth resulting from chronic malnutrition and inadequate dietary intake over a prolonged period. WHO classifies stunting as a height-for-age Z-score below -2 standard deviations from the median growth standard. Alarmingly, approximately 215 million children worldwide are affected by stunting, with Indonesia ranking fifth globally in stunting prevalence. National data indicate that stunting prevalence in Indonesia rose from 35.6% in 2010 to 37.2% in 2013, surpassing rates in other Asian countries such as Myanmar (35%), Vietnam (23%), and Thailand (16%). Despite efforts to reduce stunting rates, Indonesia continues to face significant challenges in meeting WHO's global nutrition target of a 40% reduction by 2025 (World Health Organization, 2025; Sawadogo-Lewis et al., 2021)

Recent surveys highlight Indonesia's struggle to combat stunting, ranking second highest in Southeast Asia, just behind Timor-Leste, and 115th among 151 countries globally. The Indonesian National Health Survey (Depkes RI, 2018) and the Survei Status Gizi Indonesia (Kemenkes RI, 2023) reported that 21.6% of Indonesian children remain stunted, exceeding WHO's standard threshold of below 20%. While some progress has been made, stunting prevalence in Central Java remains at 20.8%, with wasting (7.9%) and underweight (17.6%) also posing concerns (Badan Kebijakan Pembangunan Nasional, 2023).Stunting is a serious public health problem with long-term consequences on physical growth, cognitive development, and socioeconomic productivity. Children with stunting face learning difficulties, lower academic performance, and reduced economic potential in adulthood, perpetuating intergenerational cycles of poverty. Furthermore, stunted individuals are at higher risk for chronic diseases, including diabetes and cardiovascular disorders, increasing healthcare burdens in later life (Karlsson et al., 2022; Pitoyo et al., 2022)

To address Indonesia's stunting crisis, the government has implemented various intervention programs, including nutritional supplementation, maternal health programs, and exclusive breastfeeding campaigns, with a primary focus on the first 1,000 days of life (from pregnancy to a child's second birthday)(Kemenkes RI, 2018). This period is considered a critical "golden window" for determining lifelong health outcomes. Additionally, herbal supplementation is emerging as a promising complementary strategy to improve nutritional intake and support growth in stunted children (Indonesia KKR, 2021; Kemenkes RI, 2023)Among various herbal interventions, Moringa oleifera (Moringa leaves) has gained significant attention due to its high protein, vitamin, and mineral content. Moringa is widely available, cost-effective, and rich in essential nutrients, making it a sustainable option for addressing malnutrition. Studies suggest that Moringa leaf supplementation significantly improves weight gain and nutritional status in undernourished children. A 7-day intervention using 10 grams of Moringa leaf powder per day demonstrated a positive correlation between Body Mass Index (BMI) and improved nutritional outcomes in toddlers. Additionally, every 100 grams of fresh Moringa leaves contains approximately 6.7 grams of protein, highlighting its role as a potent protein source to combat malnutrition (Tawfik et al., 2021; Patil et al., 2022; Luetragoon et al., 2020).

The nutritional composition of Moringa leaves is significantly influenced by environmental factors such as altitude, temperature, and sunlight exposure, which affect the plant's growth rate and bioactive compound synthesis. Research suggests that Moringa cultivated in high-altitude regions contains higher concentrations of antioxidants, particularly flavonoids and polyphenols, due to greater environmental stress. Factors such as lower temperatures, increased UV radiation, and reduced oxygen levels stimulate the plant's defense mechanisms, enhancing the production of secondary metabolites that contribute to its nutritional and medicinal value (Kurnianingsih et al., 2021). These antioxidants play a crucial role in supporting immune function, reducing inflammation, and promoting overall health, making highland Moringa a potentially superior source for nutritional supplementation. In contrast, Moringa grown in lowland areas exhibits faster growth rates and higher biomass production, making it more accessible and suitable for large-scale cultivation. However, due to warmer temperatures, lower UV exposure, and reduced environmental stress, the concentration of bioactive compounds in lowland Moringa may be comparatively lower than in high-altitude varieties. These differences highlight the importance of selecting optimal Moringa sources for nutritional interventions, particularly in addressing malnutrition and stunting in children. By identifying and utilizing the most nutrient-dense Moringa varieties, researchers and policymakers can develop more effective supplementation strategies, ensuring maximum health benefits and improves nutritional outcomes (Leone et al., 2015; Leone et al., 2016 ;Ramesh M, 2019).This study aims to systematically review and compare the nutritional

composition of dried Moringa leaves from highland and lowland regions, with a focus on key bioactive compounds such as flavonoids and proteins, which are essential for supporting growth in stunted children.

METHOD

This study employs a Systematic Literature Review (SLR) approach to evaluate the nutritional potential of Moringa oleifera as a supplement for improving weight and height in stunted children. The review aims to identify the best Moringa leaf source for extract production, focusing on variations in nutrient composition due to geographical differences and their potential impact on growth outcomes.

1. Literature Search Strategy
   The literature search for this study was conducted using three major academic databases: Google Scholar, ScienceDirect, and PubMed. These databases were selected to ensure access to high-quality, peer-reviewed research on the nutritional properties of Moringa oleifera and its potential role in addressing stunting in children. The search focused on articles published between 2014 and 2024, ensuring that the study incorporated recent and relevant findings on Moringa's nutritional composition, bioactive compounds, and effects on growth outcomes.
   To refine the search and retrieve the most relevant studies, a combination of keywords and Boolean operators was used. The search terms included "Moringa oleifera AND nutritional composition AND altitude" to identify studies comparing geographical variations in Moringa's nutrient content, "Moringa extract AND malnutrition AND stunting" to explore its effectiveness as a nutritional intervention, and "Moringa supplementation AND child growth" to assess its impact on weight gain and height improvement in stunted children. These search parameters allowed for a comprehensive review of existing literature, ensuring that only studies relevant to Moringa's nutritional value and its role in combating malnutrition were included in the analysis.
2. Selection Criteria (PICOS)
   The study selection process was conducted using the PICOS (Population, Intervention, Comparison, Outcome, and Study Design) framework to ensure relevance and methodological rigor in identifying the most suitable literature for review. The population (P) targeted in this study consisted of children affected by malnutrition or stunting**,** as these groups are the primary focus of nutritional intervention research. The intervention (I) examined involved the use of Moringa oleifera as a nutritional supplement in various forms, including raw leaves, extracts, or formulated supplements, to assess its potential benefits in addressing growth deficiencies. To ensure comparative analysis, the comparison (C) component included studies that assessed Moringa supplementation in contrast to other nutritional interventions or standard dietary intake, providing insights into its relative effectiveness. The outcomes (O) of interest were focused on evaluating improvements in weight gain, height growth, and overall nutritional status, which serve as key indicators of successful malnutrition intervention. In terms of study design (S)**,** the review prioritized high-quality research methodologies**,** including randomized controlled trials (RCTs), cohort studies, case-control studies, and systematic reviews. These study types were selected for their ability to provide robust evidence on the effects of Moringa supplementation in promoting growth and improving nutritional outcomes in children. By applying the PICOS framework, this study ensured a structured and comprehensive approach in identifying relevant literature that aligns with the research objectives.
3. Screening and Data Extraction
   The initial literature search identified a total of 70 articles related to Moringa oleifera and its potential role in addressing stunting in children. To ensure the selection of

relevant and high-quality studies, a systematic screening process was carried out. First, duplicate articles were removed, followed by a title and abstract review, which resulted in 35 studies that met the preliminary inclusion criteria. A full-text assessment was then conducted to evaluate the study design, research focus, and data relevance. During this process, 30 studies were excluded due to factors such as irrelevant study designs, lack of specific focus on Moringa, or insufficient data on child growth outcomes. Ultimately, 6 studies met the eligibility criteria for in-depth analysis and were included in the final review. The selected studies provided key data on the geographical origin of Moringa samples (highland vs. lowland), nutritional composition (including protein, flavonoids, and other bioactive compounds), dosage and duration of supplementation, impact on weight gain and height growth, as well as study limitations and methodological quality. These data points were systematically analyzed to gain insights into how environmental factors influence Moringa's nutritional value and its effectiveness as a nutritional intervention for stunted children.

4. Data Analysis and Synthesize
   The extracted data were systematically analyzed to compare nutrient variations in Moringa from different geographical regions and their effects on stunting intervention outcomes. A qualitative synthesis was performed, categorizing findings based on nutrient content differences, intervention effectiveness, and potential implications for child growth.

RESULT

After a thorough screening process, a total of 6 (six) articles were identified as relevant to the research focus and met the established inclusion criteria. These selected studies were obtained from Google Scholar, ScienceDirect, and PubMed and are presented below.

1. A Comparative Study of Components of Moringa oleifera Leaves from Different Regions in Yunnan (Yajie et al., 2016)
   A study by Yajie et al. (2016) analyzed Moringa leaves from six regions in Yunnan province, China. The findings revealed that leaves from Dehong had the highest protein content (28.4%) and vitamin C levels (150.00 mg/100g). Leaves from Pu'er exhibited the highest soluble polysaccharide (13.27%) and crude fiber (34.47%) contents. Calcium content was highest in leaves from Dali (2.78%). These variations underscore the impact of regional differences on the nutritional composition of Moringa leaves.
2. Comparison Of Iron (Fe) Levels in Moringa Leaf (Moringa oleifera) Growing in Highlands and Lowlands by Atomic Absorption Spectrophotometry (AAS) (Pratiwi et al., 2021)
   Research by Pratiwi et al. (2021) focused on the iron (Fe) levels in Moringa leaves grown in highland and lowland areas. Using Atomic Absorption Spectrophotometry, the study found that the average iron content was 6.26 mg/100g in highland leaves and 6.16 mg/100g in lowland leaves. Statistical analysis revealed no significant difference between the two regions, indicating that elevation may not markedly affect iron content in Moringa leaves.
3. Recent Advances in Drumstick (Moringa oleifera) Leaves Bioactive Compounds: Composition, Health Benefits, Bioaccessibility, and Dietary Applications (Kashyap et al., 2022)
   A comprehensive review by Kashyap et al. (2022) examined the nutritional composition of Moringa leaves, highlighting variations due to cultivation conditions. The study noted that Moringa leaves are rich in crude protein (ranging from 10.74% to 30.29%), carbohydrates (13.41% to 63.11%), and essential amino acids. Mineral content, including calcium, iron, and potassium, also varies based on environmental factors. While the review did not focus exclusively on elevation, it emphasized that climatic and soil conditions significantly influence the nutritional profile of Moringa leaves.

4. Comparison of Vitamin C Levels in Moringa Oleifera Leaves Which Grow in the Lower Plains, Middle Lowlands and Highlands (Saputri et al., 2022)
   A study by Saputri et al (2022) investigated the vitamin C levels in Moringa leaves harvested from lowland (2.5 meters above sea level), midland (325 meters), and highland (823 meters) areas. The results indicated that vitamin C content was highest in leaves from the highland region (0.325%), followed by midland (0.1951%), and lowest in lowland leaves (0.0975%). This suggests that elevation influences the vitamin C concentration in Moringa leaves.
5. Nutritional Composition and Mineral Profile of Leaves of Moringa oleifera Provenances Grown in Gaborone, Botswana (Masitlha et al., 2024)
   Research by Masitlha et al. (2024) assessed the nutritional and mineral content of Moringa leaves in Gaborone, Botswana. The study found that the leaves contained significant amounts of calcium (520 mg/100g), iron (7.7 mg/100g), and magnesium (82.6 mg/100g). The high ash content (7.4%) indicates a substantial mineral presence. While the study did not specify the elevation of the cultivation sites, it highlights the rich mineral profile of Moringa leaves in the region.
6. Administration Effectiveness of Moringa Leaf Extract With an Automatic Extraction System on IL-6 Levels in Protein Energy Deficiency (PEM) Rats (Aquarista, 2024)
   A study by Aquarista et al (2024), which utilized a true experimental design on male Wistar rats, found that Moringa leaf extract, both in fresh and dried forms, had a positive impact on body weight and body length. both types of extract contributed to growth improvement. Further statistical testing demonstrated significant differences before and after treatment in IL-6 levels ($p = 0.028$), body weight ($p = 0.007$), and body length ($p = 0.009$ and 0.011). However, no significant changes were observed in inflammation status ($p > 0.05$). Additionally, the effectiveness test showed that the extract had a statistically significant impact on weight gain ($p = 0.002$), while its effect on other growth parameters was not as pronounced, with dried Moringa leaf extract showing the most significant effect

DISCUSSION

The findings from this systematic literature review highlight the nutritional variations in Moringa oleifera leaves based on geographical differences and their potential impact on stunting interventions. The reviewed studies demonstrate that altitude, soil composition, and climatic conditions significantly influence the concentration of bioactive compounds, including proteins, vitamins, minerals, and antioxidants. These variations play a crucial role in determining the effectiveness of Moringa supplementation in improving weight gain and height growth in malnourished children.Several studies analyzed in this review confirm that Moringa leaves grown in highland regions tend to have higher concentrations of certain nutrients, particularly vitamin C and proteins, compared to those grown in lowland areas. Research by Chu Yajie et al (2016) and Purwanti (2021) found that highland Moringa contained significantly higher vitamin C levels, which may be attributed to greater exposure to UV radiation and environmental stressors that trigger an increase in antioxidant production (Yajie et al., 2016). This suggests that highland Moringa may provide greater benefits in combating oxidative stress and improving immune function in children suffering from malnutrition.

On the other hand, Moringa cultivated in lowland areas generally exhibits higher biomass production and leaf yield, making it more accessible for large-scale cultivation. However, the study by Pratiwi et al. (2021) found no significant difference in iron content between Moringa leaves from highland and lowland regions, suggesting that certain mineral levels remain relatively stable regardless of altitude. This finding aligns with the comprehensive review by Saini et al. (2022), which emphasized that Moringa’s mineral composition is largely

influenced by soil quality and agricultural practices rather than altitude alone.In addition to its nutritional composition, studies assessing the biological effects of Moringa supplementation provide further insights into its potential as a nutritional intervention for stunting. The experimental study by Aquarista et al (2024) demonstrated that both fresh and dried Moringa leaf extracts had a positive effect on weight and body length in malnourished rats (Aquarista, 2024). However, statistical analysis revealed that only weight gain was significantly improved ($p = 0.002$), with dried Moringa extract showing the most pronounced effect. This suggests that dried Moringa leaf extract may be more potent or concentrated, possibly due to the reduction of water content, leading to higher nutrient density per unit weight.

Furthermore, the study also found a significant reduction in IL-6 levels ($p = 0.028$), indicating that Moringa extract may have anti-inflammatory properties beneficial for malnourished individuals who often experience chronic low-grade inflammation. However, no significant improvements in overall inflammation status ($p > 0.05$) were observed, suggesting that while Moringa may help regulate specific inflammatory markers, additional dietary interventions may be required to achieve broader immunological benefits (Aquarista, 2024).The findings of this review suggest that Moringa oleifera could be a valuable supplement for addressing childhood malnutrition, particularly in regions where access to diverse protein sources and micronutrients is limited. However, the effectiveness of Moringa supplementation may depend on multiple factors, including geographical origin, processing methods, and dosage levels (Kurnianingsih et al., 2023) .Given the observed nutritional variations between highland and lowland Moringa, it is essential to standardize extraction methods and optimize supplement formulations to maximize its benefits. The high vitamin C and protein content in highland Moringa suggests that it could be more beneficial for immune support and growth, while lowland Moringa's greater availability makes it a practical choice for large-scale interventions. Future research should focus on identifying the most effective formulations and delivery methods to ensure optimal absorption and utilization of Moringa's nutrients in children with stunting.

While this systematic review provides valuable insights into Moringa's nutritional potential, several limitations must be acknowledged. First, most studies focused on nutrient composition rather than clinical outcomes, making it difficult to determine the long-term effects of Moringa supplementation on child growth. Second, variability in study methodologies—including different drying and extraction techniques—may contribute to inconsistencies in reported nutrient levels. Lastly, few studies directly compared growth outcomes in human subjects, highlighting the need for large-scale clinical trials to validate Moringa's efficacy as a stunting intervention.

CONCLUSION

This review highlights the potential of Moringa oleifera as a sustainable solution for childhood malnutrition, with highland and lowland varieties having different benefits. Highland Moringa contains more antioxidants and protein, while lowland Moringa is easier to cultivate on a large scale. The findings suggest that Moringa supplementation, especially in dried extract form, can help increase weight and reduce inflammation, making it a promising option for stunting prevention programs. However, further research is needed to standardize formulations, determine the best dosage, and assess long-term health effects in malnourished children.

REFERENCES

Addae, H., Sulemana, M., Yakubu, T., Atosona, A., Tahiru, R., & Azupogo, F. (2024). Low birth weight, household socio-economic status, water and sanitation are associated with stunting and wasting among children aged 6–23 months: Results from a national survey in Ghana. PLoS ONE, 19(3).

Aquarista, N. (2024). Efektivitas pemberian ekstrak daun kelor dengan sistem ekstraksi otomatis terhadap kadar il-6 pada tikus model kurang energi protein (kep) [Poltekkes Kemenkes Semarang]. https://repository.poltekkes-smg.ac.id/index.php?p=show_detail&id=41624&keywords=aquarista

Badan Kebijakan Pembangunan Nasional. (2023). Survei Kesehtan Nasional.

Depkes RI. (2018). Riset Kesehatan Dasar (RISKESDAS) 2018.

Indonesia KKR. (2021). Buku Saku Kader Pintar Cegah Stunting (Kementerian Kesehatan Republik Indonesia (ed.)). Kementerian Kesehatan Republik Indonesia.

Karlsson, O., Kim, R., & Bogin, B. (2022). Maternal height-standardized prevalence of stunting in 67 low-and middle-income countries. Journal of Epidemiology, 32(7), 337–344.

Kashyap, P., Kumar, S., Riar, C. S., Jindal, N., Baniwal, P., Guiné, R. P. F., Correia, P. M. R., Mehra, R., & Kumar, H. (2022). Recent Advances in Drumstick (Moringa oleifera) Leaves Bioactive Compounds: Composition, Health Benefits, Bioaccessibility, and Dietary Applications. Antioxidants, 11(2), 1–37. https://doi.org/10.3390/antiox11020402

Kemenkes RI. (2018). Buletin Stunting.

Kemenkes RI. (2023). Buku Saku Hasil Survei Status Gizi Indonesia (SSGI) 2022. In Kemenkes. https://kesmas.kemkes.go.id/assets/uploads/contents/attachments/09fb5b8ccfdf088080f2521ff0b4374f.pdf

Kurnianingsih, Suharjono, A., Suryono, Widyowati, R., & Kubota, N. (2021). Optimization of Moringa Leaf Extraction and Time Series-based Forecasting for an Early Warning System during Extraction. 2021 IEEE Region 10 Symposium (TENSYMP), 1–6. https://doi.org/10.1109/TENSYMP52854.2021.9550816

Kurnianingsih, Widyowati, R., Aji, A. F., Widyawati, M. N., Aquarista, N., & Arianto, H. T. (2023). Kelor Super: Ekstraksi, Pengujian, dan Manfaatnya untuk Stunting (1st ed.). PT. Manggala Jaya Technology.

Leone, A., Spada, A., Batterzati, A., Schiraldi, A., Aristil, J., & Bertoli, S. (2016). Moringa oleifera seeds and oil: Characteristics and uses for human health. International Journal of Molecular Sciences, 17(12), 21–41.

Leone, A., Spada, A., Battezzati, A., Schiraldi, A., Aristil, J., & Bertoli, S. (2015). Cultivation , Genetic , Ethnopharmacology , Phytochemistry and Pharmacology of Moringa oleifera Leaves : An Overview. International Journal of Molecular Sciences, 16, 12791–12835. https://doi.org/10.3390/ijms160612791

Luetragoon, T., Sranujit, R. P., Noysang, C., Thongsri, Y., Potup, P., Suphrom, N., Nuengchamnong, N., & Usuwanthim, K. (2020). Bioactive compounds in moringa

oleifera Lam. Leaves inhibit the pro-inflammatory mediators in lipopolysaccharide-induced human monocyte-derived macrophages. Molecules, 25(1), 1–16. https://doi.org/10.3390/molecules25010191

Masitlha, E., Seifu, E., & Teketay, D. (2024). Nutritional composition and mineral profile of leaves of Moringa oleifera provenances grown in Gaborone, Botswana. Food Product Process and Nutrition, 6(2). https://doi.org/10.1186/s43014-023-00183-8

Patil, S., Mohite, B., Marathe, K., & Salunkhe, N. (2022). Moringa tree, gift of nature: a review on nutritional and industrial potential. Current Pharmacology Reports, 8(4), 262–280.

Pitoyo, A., Saputri, A., Agustina, R., & Handayani, T. (2022). Analysis of determinan of stunting prevalence among stunted toddlers in Indonesia. Populasi, 30(1), 36.

Pratiwi, A., Nofita, & Winahyu, D. (2021). Perbandingan kadar besi (fe) pada daun kelor (moringa oleiera) yang tumbuh di dataran tinggi dan dataran rendah secara spektrofotometri serapan atom (ssa). Jurnal Analis Farmasi, 6(2), 102–108. https://doi.org/10.33024/jaf.v6i2.5945

Ramesh M, E. S. (2019). Moringa (Moringa oleifera Lam.): A Review. International Journal of Homeopathic Sciences, 3(4), 37–40. https://doi.org/https://doi.org/:10.17660/ActaHortic.2011.911.58

Saputri, A., Purwanti, R., & Christiandari, H. (2022). Perbandingan kadar vitamin c pada daun kelor (moringa oleifera) yang tumbuh di datararan rendah, dataran rendah menengah dan dataran tinggi. Jurnal Permata Indonesia, 13(1), 62–67. https://doi.org/10.59737/jpi.v13i1.46

Sawadogo-Lewis, T., King, S., Agung, T., & Roberton, T. (2021). The potential contribution of the health system to reducing stunting in SUN countries. Food and Nutrition Bulltetin, 42(2), 159–169.

Tawfik, M., Mohammed, M., Sadak, M., & Thalooth, A. (2021). Iron oxide nanoparticles effect on growth, physiological traits and nutritional contents of Moringa oleifera grown in saline environment. Bulletin of National Research Centre, 49(2021), 1–9.

UNICEF Indonesia. (2022). Laporan Tahunan UNICEF Indonesia 2022. In UNICEF Laporan Tahunan Indonesia 2022.

WHO. (2020). Global Nutrition Report: Action on Equity to End Malnutrition.

World Health Organization. (2025). Global Targets 2025: To improve maternal, infant and young child nutrition. Nutrition and Food Safety. https://www.who.int/teams/nutrition-and-food-safety/global-targets-2025

Yajie, C., Shiguan, F., & Jiashun, G. (2016). A comparative study of components of moringa oleifera leaves form different regions in Yunnan. Journal of Food Science, 2, 160–164. https://doi.org/Doi:10.7506/spkx1002-6630-201602028