JGPS, November 2025, Volume 9 Nomor 2
ISSN 2599-0152 eISSN 2599-2465
http://jos.unsoed.ac.id/index.php/jgps

AMINO ACID, PROTEIN, AND COLOR PROFILE OF SWEET CORN EXTRACT SUBSTITUTED WITH MORINGA LEAF EXTRACT

Profil Asam Amino, Protein Dan Warna Ekstrak Jagung Manis Yang Disubtitusi Ekstrak Daun Kelor

Widodo[1], Siti Tamaroh Cahyono Murti[1]*, Bayu Kanetro[1]
Magister Ilmu Pangan, Fakultas Agroindustri, Universitas Mercu Buana Yogyakarta, Yogyakarta, Indonesia
Email: tamaroh@mercubuana-yogya.ac.id

ABSTRACT

*Sweet corn (Zea mays saccharata) is a popular source of carbohydrates and dietary fiber but has a relatively low protein content. To increase its nutritional value and functional potential, substitution was carried out with Moringa oleifera leaf extract which is rich in essential amino acids and bioactive compounds. This study aims to evaluate the effect of Moringa leaf extract substitution on the amino acid profile and color characteristics of sweet corn extract. The study design was a Completely Randomized Design (CRD) with two treatments, namely substitution of the addition of Moringa leaf extract, young and old shoots, in the ratio of sweet corn extract and Moringa leaf extract (80:20; 85:15 and 90:10). The test on the research results was carried out on color, the color was carried out using a colorimeter with parameters L * (brightness), a * (red-green), and b * (yellow-blue), protein content. The amino acid profile test was selected on the best research results using high-performance liquid chromatography (HPLC). The data obtained were statistically tested using Analysis of Variance (ANOVA). If there was a significant difference between treatments, it was continued with the Duncan test (DMRT). The results showed that increasing the concentration of Moringa leaf extract significantly reduced the L * value and increased the a * value ($p<0.05$), indicating a more intense green color, without significant changes in the b * value. Meanwhile, the selected product for amino acid profile testing was in the treatment of 90:10 young leaf sweet corn extract, with high amino acids in aspartic acid (114.54 mg / L), glutamic acid (222.45 mg/L) and alanine (294.73 mg/L).*

Keywords: amino acids, color moringa leaves, sweat corn.

ABSTRAK

Jagung manis *(Zea mays saccharata*) merupakan sumber karbohidrat dan serat pangan yang populer namun memiliki kandungan protein yang relatif rendah. Untuk meningkatkan nilai gizi dan potensi fungsionalnya, dilakukan substitusi dengan ekstrak daun kelor (*Moringa oleifera*) yang kaya asam amino esensial dan senyawa bioaktif. Penelitian ini bertujuan mengevaluasi pengaruh substitusi ekstrak daun kelor terhadap profil asam amino dan karakteristik warna ekstrak jagung manis. Rancangan penelitian ini adalah Rancangan Acak Lengkap (RAL) dengan dua perlakuan yaitu subtitusi penambahan ekstrak daun kelor pucuk, muda dan tua, pada perbandingan ekstrak jagung manis dan ekstrak daun kelor (80:20 ;85:15 dan 90:10). Uji pada hasil penelitian dilakukan pada warna, warna dilakukan menggunakan colorimeter dengan parameter L* (kecerahan), a* (merah–hijau), dan b* (kuning–biru), kadar protein. Uji profil asam amino dipilih pada hasil penelitian terbaik dengan menggunakan kromatografi cair kinerja tinggi (HPLC). Data yang diperoleh diuji statistik menggunakan Analysis of Variance (ANOVA). Jika terdapat perbedaan nyata antar perlakuan, dilanjutkan dengan uji Duncan (DMRT). Hasil penelitian menunjukkan peningkatan konsentrasi ekstrak daun kelor menurunkan nilai L* dan meningkatkan nilai

DOI 10.20884/1.jgipas.2025.9.2.18078

a* secara signifikan (p<0,05), menandakan warna hijau lebih intens, tanpa perubahan nyata pada nilai b*. Sedangkan produk terpilih untuk diuji profil asam aminonya pada perlakuan ekstrak jagung manis 90:10 daun muda, dengan asam amino yang tinggi pada asam aspartat (114,54 mg/L), asam glutamat (222,45 mg/L) dan alanin (294,73 mg/L).

Kata kunci: asam amino, daun kelor, jagung manis, warna.

INTRODUCTION

Enhancing the nutritional value and sensory quality of local food ingredients presents a significant challenge in the development of functional products derived from Indonesia's natural resources. Sweet corn (Zea mays saccharata) represents a viable food commodity due to its sweetness, tender texture, and substantial carbohydrate and dietary fiber content. Additionally, sweet corn is a source of vitamins, carotenoids, and phenolic acids, which function as natural antioxidants (Rahabite et al., 2025). Sweet corn has limitations regarding protein content, particularly due to the low levels of essential amino acids like lysine and tryptophan. This condition leads to the suboptimal biological value of sweet corn protein as a high-quality vegetable protein source (Amalia et al., 2022).

Natural additives that provide complete protein and essential amino acids are necessary to improve the functional and nutritional value of sweet corn-based products. Moringa oleifera leaves represent a strong candidate due to their comprehensive profile of essential amino acids, including lysine, leucine, and methionine. Additionally, they are abundant in vitamins A, C, and E, as well as flavonoids and polyphenols, which serve as potent antioxidants (Sari et al., 2024). Consequently, the incorporation of moringa leaf extract into sweet corn extract is anticipated to enhance nutritional content, particularly regarding protein and amino acids, while also offering additional functional benefits for the body.

The application of moringa leaf extract presents challenges regarding its physical characteristics, especially in relation to color. Color serves as a crucial sensory attribute that markedly affects consumer perceptions regarding the quality and acceptability of food products (Rifqi et al., 2022). The incorporation of green-colored components, such as moringa leaves, may decrease brightness (L* value) and shift the color spectrum towards green (negative a* value), thus modifying consumers' visual perception of the product. An objective study utilizing the CIE Lab* color system is necessary to

DOI 10.20884/1.jgipas.2025.9.2.18078

assess the impact of moringa leaf extract substitution on the color parameters of sweet corn extract. The amino acid profile is a critical factor in assessing the protein quality of the resulting combination product, alongside color characteristics. The amino acid profile analysis will reveal the degree to which moringa leaf extract enhances the essential amino acid composition and elevates the biological value of sweet corn extract protein. This study examines the enhancement of nutritional content alongside the equilibrium between aesthetic appeal and chemical quality of the final product.

This study primarily investigates the impact of Moringa leaf extract substitution on the color changes and amino acid profile of sweet corn extract. Excessive color alterations may diminish visual attractiveness, whereas enhancing essential amino acid content is anticipated to elevate the product's nutritional quality. A scientific approach is required to thoroughly evaluate both aspects of this problem. This study aimed to analyze the impact of varying amounts of Moringa leaf extract on the color and protein characteristics of sweet corn extract, as well as to identify the amino acids present in the sweet corn extract with the addition of Moringa leaf extract.

MATERIALS AND METHODS

Research Design

This research employed a Completely Randomized Design (CRD) incorporating three treatment factors: the proportion of sweet corn extract (90%, 80%, and 70%), the quantity of moringa leaves (10%, 15%, and 20%), and the type of moringa leaf shoots (shoots, young, and old). The treatments included the following:

P1 = 90% sweet corn extract + 10% moringa shoots leaves extract

P2 = 90% sweet corn extract + 10% moringa young leaves extract

P3 = 90 % sweet corn extract + 10% moringa mature leaves extract

P4 = 85 % sweet corn extract + 15% moringa shoots leaves extract

P5 = 85 % sweet corn extract + 15% moringa young leaves extract

P6 = 85 % sweet corn extract + 15% moringa mature leaves extract

P7 = 80% sweet corn extract + 20% moringa shoots leaves extract

P8 = 80% sweet corn extract + 20% moringa young leaves extract

P9 = 80% sweet corn extract + 20% moringa mature leaves extract

The parameters observed comprised amino acid profiles, which were analyzed through high-performance liquid

DOI 10.20884/1.jgipas.2025.9.2.18078

chromatography (HPLC). Color characteristics were quantified utilizing a colorimeter (model CIE L*A*B*), yielding measurements of brightness (L*), redness (A*), and yellowness (B*).

Place and Time of Research

The study was carried out at the Laboratory of Chemistry and Agricultural Product Technology Process Engineering, Faculty of Agroindustry, Mercu Buana University Yogyakarta, focusing on the extraction and color analysis phases. The Integrated Research and Testing Laboratory (LPPT) at Gadjah Mada University Yogyakarta conducts amino acid profile analysis utilizing HPLC techniques. The research spanned three months, from May to July 2025, encompassing various stages: preparation of materials and tools in May, extraction of sweet corn and moringa leaves in June, and color and amino acid analysis, along with data processing and report preparation, in July.

Materials and Tools

The primary components include fresh sweet corn, shoots, and both young and mature moringa leaves. The solvents employed are distilled water and 95% ethanol. The primary equipment consists of a blender, a filter cloth extraction apparatus, a colorimeter (Minolta CR-400 Chromameter), and High-Performance Liquid Chromatography (HPLC).

Extraction Procedure

The procedure for producing sweet corn extract involves the preparation of 3 kg of sorted and cleaned sweet corn, including the removal of corn silk. The corn is then blanched for 5 minutes at 90°C. Following this, the kernels are sliced from the cob, and 600 g of sweet corn is weighed. The sweet corn is blended for 4 minutes with the addition of 600 mL of water. Finally, the sweet corn extract is obtained using a filter cloth. Fresh moringa leaves are categorized into three types, then blanched for five minutes at 90°C. A mixture is prepared using 600 g of sweet corn and 600 mL of water. For the moringa leaves, 500 g is combined with 500 mL of water, extracted through a filter cloth for 30 minutes, and subsequently stored in a bottle. The extract mixture was prepared using the following ratio: P1 = 90% sweet corn extract and 10% moringa shoot leaves extract; P2 = 90% sweet corn extract and 10% moringa young leaves extract; P3 = 90% sweet corn extract and 10% moringa mature leaves extract; P4 = 85% sweet corn extract and 15% moringa shoots leaves

DOI 10.20884/1.jgipas.2025.9.2.18078

extract; P5 = 85% sweet corn extract and 15% moringa young leaves extract; P6 = 85% sweet corn extract and 15% moringa mature leaves extract; P7 = 90% sweet corn extract and 20% moringa shoots leaves extract; P8 = 90% sweet corn extract and 20% moringa young leaves extract; P9 = 90% sweet corn extract and 20% moringa mature leaves extract**.**

Color Analysis

The color of the sample was measured using a colorimeter with the CIE Lab* system, where L* indicates brightness (0 = black, 100 = white), a* indicates the direction of red (+) or green (−), b* indicates the direction of yellow (+) or blue (−).

Protein Analysis

Determination of protein content utilising the micro Kjeldahl method (AOAC, 2005).

Amino Acid Content Analysis

Analysis of amino acid concentrations using the HPLC technique. The High Performance Liquid Chromatography (HPLC) method for determining amino acid levels commences with sample preparation, specifically the hydrolysis of protein into free amino acids. This is achieved using a 6 N HCl solution at 110°C for 24 hours under closed conditions to prevent evaporation. Following hydrolysis, the sample undergoes filtration and neutralization, subsequently being derivatized with reagents like orthophthaldialdehyde (OPA) or phenylisothiocyanate (PITC) to enhance detection sensitivity and selectivity. The derivatized sample is subsequently injected into the HPLC system, which comprises a pump, a stationary phase column (C18 column), and a data acquisition system. Elution is performed using a mobile phase consisting of a mixed solvent (phosphate buffer and acetonitrile) that flows either isocratically or in a gradient at a specified flow rate. The separation of amino acids is determined by the interactions between the target molecule, the stationary phase, and the mobile phase, resulting in each amino acid eluting at a specific retention time. The quantification of amino acid levels is achieved by comparing the peak area of the chromatogram to that of a standard amino acid of known concentration, facilitating accurate and precise measurement of each amino acid component in the sample.

Statistic Analysis

Data were analyzed through ANOVA. In cases where significant

DOI 10.20884/1.jgipas.2025.9.2.18078

differences were identified, the Duncan Multiple Range Test (DMRT) was applied at a 95% confidence level.

RESULT AND DISCUSSION

Results of Color Testing for Sweet Corn and Moringa Leaf Extract.

Color is a critical visual attribute that influences the attractiveness, quality, and acceptability of food products. Color functions as both an aesthetic indicator and a reflection of the chemical properties, ripeness, and freshness of a product. Color alterations may result from processing, chemical reactions, or the incorporation of specific ingredients, including natural pigments. The color table is presented below. Table 1 presents the results of color measurements for corn and moringa leaf extracts.

Table 1. Results of Measuring The Color of Corn and Moringa Leaf Extracts.

Sample	L	a*	b*	c*	h*
80:20S	61.85±0.28^{cd}	-3.61±0.01^{bc}	24.64±0.35^{b}	24.80±0.21^{c}	94.72±0.22^{d}
85:15S	64.88±0.23^{e}	-3.46±0.28^{c}	24.74±0.57^{b}	25.91±0.05^{d}	93.43±0.14^{c}
90:10S	64.69±0.12^{e}	-2.22±0.06^{e}	24.21±0.30^{b}	26.53±0.09^{e}	90.88±0.02^{a}
80:20Y	57.17±0.75^{a}	-4.24±0.06^{a}	22.07±0.12^{a}	22.47±0.13^{a}	94.90±0.04^{d}
85:15Y	62.09±0.04^{d}	-4.11±0.06^{a}	24.32±0.48^{b}	23.60±0.71^{b}	90.37±0.66^{a}
90:10Y	62.02±0.10^{d}	-2.83±0.21^{d}	26.33±0.01^{e}	26.62±0.03^{e}	92.68±0.11^{b}
80:20M	58.24±0.06^{b}	-3.90±0.18^{ab}	24.47±0.57^{b}	23.82±0.03^{b}	99.97±0.00^{f}
85:15M	61.35±0.04^{c}	-3.26±0.13^{c}	25.80±0.24^{e}	25.88±0.08^{d}	96.37±0.57^{e}
90:10M	64.30±0.13^{e}	-2.50±0.13^{de}	24.71±0.14^{b}	24.79±0.03^{c}	95.11±0.01^{d}

Different superscript letters in each column denote statistically significant differences at the 95% confidence level ($p<0,05$). S=shoots; Y=young; M=mature.

The L* value quantifies color brightness, with higher values signifying increased brightness (Nurjadidah et al., 2023). The data indicate that the samples exhibiting the highest L* values were the 85:15% shoots leaf (64.88±0.23) and the 90:10% leaf shoots (64.69±0.12), suggesting that corn extract combined with moringa leaf shoots results in a brighter color (Viani, 2023). The 80:20 young leaf sample exhibited the lowest L* value (57.17±0.75), signifying a darker coloration. The brightness of color is significantly affected by the presence of pigments and bioactive compounds, including chlorophyll and flavonoids, in moringa leaf extract (Mukarromah et al., 2021). Increased concentrations of Moringa leaf shoots correlate with a more intense color, likely attributable to elevated levels of chlorophyll pigments present in the leaf shoots.

The a* value indicates a negative green-red color, while a negative value

DOI 10.20884/1.jgipas.2025.9.2.18078

denotes a greenish nuance. All samples exhibited a negative a* value, signifying a predominant green hue. In the 80:20 corn extract of young moringa leaves, the a* value was recorded at -4.24±0.06, signifying the highest intensity of green coloration. The 90:10 corn extract of young moringa leaves exhibited a lower a* value in greenish intensity (-2.22±0.06), indicating a less vibrant green color. The b* value, representing a yellow-blue nuance, predominantly exhibited a yellowish hue with values ranging from 22 to 26. The 90:10 corn extract of young moringa leaves exhibited the highest b* and chroma (c*) values (26.33 and 26.62), signifying the brightest and most intense color. A high chroma value indicates a more intense color, which is visually more attractive and stable (Rasyidi et al., 2024). Intense colors in food products are frequently sought after due to their association with freshness and elevated nutritional value. The hue angle (h°) value characterizes the nature of the negative dominant color, indicating a color shift between green and yellow.

The corn extract and old moringa leaves exhibited the highest value at a ratio of 80:20 (99.97±0.00), characterized by a pronounced yellowish hue. In contrast, the 85:15 corn extract of young moringa leaves recorded the lowest value (90.37±0.66), suggesting a color inclination towards green (Rizki et al., 2023). The observed pattern indicates that the older regions of the leaf exhibit a more yellow hue, whereas the younger leaves display a greener coloration. This aligns with the observation that young moringa leaves possess higher chlorophyll content compared to older leaves, which are characterized by increased levels of xanthophylls, resulting in a yellow coloration. Variations in leaf age and extract concentration significantly influence the visual characteristics of the final product, impacting consumer perceptions of quality and freshness.

A significant decrease in the L* value ($p<0.05$) was observed with increasing concentrations of Moringa leaves, indicating a darker mixture. The a* value transitioned from negative to positive, indicating a color shift from greenish to slightly reddish, likely resulting from the interaction between chlorophyll and phenolic compounds. The b* value decreased, signifying a reduction in the predominant yellow hue of the corn extract. This image depicts sweet corn extract combined with Moringa leaf extract during the color test. Figure 1 illustrates the results of the study involving corn extract and the addition of Moringa leaf extract.

DOI 10.20884/1.jgipas.2025.9.2.18078

Figure 1. Sweet Corn and Moringa Leaves Extracs.

Results of Protein Content

The protein content in moringa leaf extract is a critical parameter, as it directly correlates with the nutritional value and bioactive potential of organic nitrogen compounds, including enzymes, bioactive peptides, and essential amino acids. Table 2 presents the protein test results for sweet corn and moringa leaf extracts.

Table 2. Protein Content of Sweet Corn and Moringa Leaves Extracs

Sweet corn + moringa leaves extract	Protein (% dw)
80:20S	11.94±0.70^{de}
85:15S	12.79±5.86^{de}
90:10S	10.11±0.14^{cde}
80:20Y	3.82±0.00^{a}
85:15Y	4.38±0.09^{ab}
90:10Y	3.62±0.11^{a}
80:20M	8.31±0.70^{abcd}
85:15M	8.32±3.01^{abcd}
90:10M	6.74±0.64^{abc}

Different superscript letters denote statistically significant differences at the 95% confidence level (p<0,05).
S=shoots; Y=young; M=mature; dw=dry weight.

The protein content of the sweet corn extract and moringa leaves combination exhibited significant variation across treatments. The analysis results indicate that the sample comprising 85% sweet corn extract and 15% moringa shoots leaves (85:15P) exhibited the highest protein content at 12.79±5.86% (bk). This was followed by the 80:20P sweet corn extract, which had a protein content of 11.94±0.70%. In contrast, previous studies reported the protein content of yogurt with moringa leaf extract to average between 5.02% and 6.53% (Fatmawati, 2020).

DOI 10.20884/1.jgipas.2025.9.2.18078

The results demonstrate that during the shoot phase, the organic nitrogen compound (protein) remains active and abundant, particularly when paired with Moringa leaves, which are inherently high in protein and essential amino acids. Moringa leaves (Moringa oleifera) contain approximately 25-30% protein by dry weight and provide all nine essential amino acids, establishing them as an excellent source of plant-based protein (Ilona & Ismawati, 2015).

The extracts of sweet corn and mature moringa leaves, when combined in varying proportions, exhibited a significantly reduced protein content. The sweet corn extract sample with the addition of young moringa leaves at a ratio of 90:10 exhibited a protein content of 3.62±0.11%, whereas the mature moringa leaf extract at the same ratio demonstrated a protein content of 6.74±0.64%. The low protein content may result from reduced metabolic activity in young and mature leaf tissue that has undergone lignification or a decline in biosynthetic enzymes. The corn variety remains unchanged; however, the inclusion of moringa leaves introduces a significant difference. The incorporation of moringa leaf extract notably enhances the nutritional profile, particularly in protein content, which is positively correlated with the amount of moringa leaf extract added (Baharudin et al., 2023).

Moringa leaves exhibit a relatively high Protein Digestibility Corrected Amino Acid Score (PDCAAS), nearing the FAO standard range of 0.62 to 0.91. The protein derived from the combination of sweet corn and moringa leaves, particularly in the 85:15P treatment, demonstrates both a higher quantitative yield and the potential for superior nutritional quality. The incorporation of moringa leaf shoots at a concentration of 15% demonstrates optimal synergy while maintaining the protein content of sweet corn without dilution effects. The combination of sweet corn extract and moringa leaf shoots in an 85:15P ratio demonstrated the highest protein content relative to other treatments. Physiologically, moringa leaf shoots exhibit elevated levels of photosynthesis and protein metabolism, thereby ensuring optimal nutrient content, as supported by research (Sadiah & Indiarto, 2022). The inclusion of a moderate proportion of moringa leaves (15%) effectively enhanced protein content while maintaining color stability and other sensory attributes. Consequently, the integration of sweet corn extract with 10% young moringa leaves presents significant potential as a raw material for functional food products,

DOI 10.20884/1.jgipas.2025.9.2.18078

characterized by high protein content and favorable nutritional quality (Andri et al., 2020).

Amino Acids Content

This study selected a 90:10 sweet corn extract and young moringa leaves treatment for amino acid profile analysis due to its superior antioxidant activity and preference among panelists. Amino acids are organic compounds that constitute proteins, comprising amino and carboxyl functional groups. Amino acids serve to construct body tissues, enzymes, and hormones. Twenty types of amino acids exist, of which nine are essential and must be acquired through dietary sources. Table 3 presents the results below.

Table 3. Results of Amino Acid Test (mg/L) of Sweet Corn Extract with The Addition of Young Moringa Leaf Extract 90:10.

Amino Acids List	Concentration (mg/L)	Information
L-Aspartic Acid	114.54	Non-Essential, high
L-Glutamic Acid	222.45	Non- Essential, high
L-Asparagine	2.59	Low
L-Histidine + L-Serine	162.22	Combination of two amino acids
L-Glutamine	<0.005	Not-detected
L-Threonine	41.56	Essential
L-Glycine	68.60	Non-Essential
L-Arginine	33.77	Semi-Essential
L-Alanine	294.73	Non-Essential, the highest
L-Tyrosine	83.18	Semi-Essential
L-Tryptophan + L-Methionine	13.49	Essential
L-Valine	30.67	Essential
L-Phenylalanine	32.41	Essential
L-Isoleucine	14.53	Essential
L-Leucine	81.21	Essential
L-Lysine	44.48	Essential

The amino acid profile analysis conducted via HPLC revealed that the combination of sweet corn extract and young moringa leaves at a 90:10% ratio exhibited diverse amino acid content, encompassing both essential and non-essential groups, consistent with the findings of Lestari et al. (2024). This profile indicates the mixture's potential as a comprehensive nutritional source, highlighting key aspects related to the diversity and concentration of each amino acid component. Non-essential amino acids comprised the majority of the total concentration in the mixture. L-Alanine exhibited the highest concentration at 294.73 mg/L, followed by L-Glutamic Acid at 222.46 mg/L, and the combination of L-Histidine and L-Serine at 162.22 mg/L. The presence of high L-Glutamic Acid content

DOI 10.20884/1.jgipas.2025.9.2.18078

is typically associated with plant materials like corn and moringa, contributing to nitrogen metabolism and serving as a precursor for the neurotransmitter glutamate (Parhusip et al., 2023). L-Alanine plays a significant role in energy conversion and glucose metabolism, whereas L-Serine is involved in the biosynthesis of proteins and nucleic acids.

Essential amino acids, including L-Leucine (81.21 mg/L), L-Lysine (44.48 mg/L), and L-Threonine (41.56 mg/L), exhibited significant concentrations, suggesting that this formulation may substantially contribute to the body's protein intake requirements. L-Leucine is recognized for its role in the maintenance and repair of muscle tissue as well as in protein synthesis (Andri et al., 2020). L-Lysine is involved in calcium absorption, collagen synthesis, and immune function. Several essential amino acids, including L-Isoleucine (14.53 mg/L) and L-Tryptophan + L-Methionine (13.49 mg/L), were identified in relatively low concentrations, which may limit the overall nutritional completeness of the protein (Annisa et al., 2024). L-Glutamine was undetectable in this mixture (<0.005 mg/L), despite its typical significant presence in plant materials. The absence may result from compound degradation during heating or storage, or from limitations of the analytical method in detecting free glutamine, considering glutamine's low stability under specific conditions. The addition of 10% moringa leaf extract enhances the overall essential amino acid profile; however, it remains inadequate to fulfill all of the body's essential requirements within a single formulation. This formulation serves as a complementary functional food rather than a primary protein source. It is advisable to combine with other foods high in methionine and isoleucine, such as nuts or animal protein, to attain a more balanced amino acid profile.

Research indicates that moringa leaves possess a comprehensive amino acid profile, encompassing essential amino acids including leucine, isoleucine, lysine, methionine, and threonine. Research conducted by Angelina et al. (2021) and Khalid et al. (2018) indicates that the concentrations of moringa leaves are as follows: Leucine: 20.50 mg/L, Valine: 22.1 mg/L, Lysine: 27.67 mg/L, Isoleucine: 31.8 mg/L. This study recorded L-Leucine at 81.21 mg/L, L-Valine at 30.67 mg/L, and L-Lysine at 44.48 mg/L, aligning with the characterization of moringa leaves as a source of high-quality protein.

DOI 10.20884/1.jgipas.2025.9.2.18078

CONCLUSION

The addition of young, shoot, and mature moringa leaf extract into sweet corn extract significantly influenced color parameters. Increased moringa concentration resulted in a darker, greener, and less yellow extract. Higher concentrations of moringa were associated with increased levels of chlorophyll and bioactive compounds. The levels of essential and non-essential amino acids rose with higher proportions of moringa leaf extract, especially in a 90:10% mixture, suggesting a potential for enhanced nutritional value stability. The protein content in sweet corn extract increased with higher concentrations of moringa leaves, and variations in leaf characteristics also influenced protein levels. The 85:15% leaf shoot extract exhibited the highest protein content at 12.79±5.86%, whereas the young leaf extract demonstrated the lowest protein content at 3.62±0.11%. The combination of sweet corn and moringa leaves enhances the natural color profile of the extract and improves protein quality by increasing amino acid diversity and quantity. This research aims to develop a functional beverage product with high protein quality in the future.

BIBLIOGRAPHY

Andri A, Harahap RP, Tribudi YA. 2020. Estimasi dan Validasi Asam Amino Metionin, Lysin, dan Threonin dari Pakan Bijian Sebagai Sumber Protein Nabati. *Jurnal Nutrisi Ternak Tropis*, *3*(1), 18–22. https://doi.org/10.21776/ub.jnt.2020.003.01.4

Angelina C, Swasti YR, Pranata FS. 2021. Increased Nutritional Value of Food Products with the Addition of Moringa Leaf Powder: A Review. *Jurnal Agroteknologi,* *15*(01). https://doi.org/10.19184/j-agt.v15i01.22089

Annisa SA, Angkasa D, Ronitawati P, Dhyani P, Fadhila R. 2024. Pengaruh Lama Waktu Fermentasi Daun Kelor (*Moringa oleifera*) dengan Bakteri Asam Laktat Terhadap Konsentrasi Asam Amino. *Jurnal Agroindustri Halal*, *10*(2), 292–302.

Baharudin RB, Ega L, Tuhumury HCD. 2023. Pengaruh Konsentrasi Ekstrak Daun Kelor (*Moringa oleifera*) Terhadap Karakteristik Bolu Kukus Labu Kuning (*Cucurbita moschata*). *Jurnal Agrosilvopasture-Tech,* *2*(2), 303–313.

Fatmawati F. 2020. Pengaruh Ekstrak Daun Kelor (*Moringa oleifera* L.) Terhadap Kualitas Yoghurt. *Indobiosains*, *2*(1), 21. https://doi.org/10.31851/indobiosains.v2i1.4344

Ilona A, Ismawati R. 2015. Inkubasi Terhadap Sifat Organoleptik Yoghurt Auc Duria Ilona. *E-Journal Boga*, *04*(3), 151–159.

Khalid A R, Elsharbasy FS, Fadlelmula AA. 2018. Nutritional Values of Moringa oleifera, Total Protein, Amino Acid, Vitamins, Minerals,

DOI 10.20884/1.jgipas.2025.9.2.18078

Carbohydrates, Total Fat and Crude Fiber, under the Semi-Arid Conditions of Sudan. *Journal of Microbial & Biochemical Technology*, *10*(2). https://doi.org/10.4172/1948-5948.1000396

Lestari SP, Aprilia H, Suarantika F. 2024. Kajian Pustaka Analisis Penetapan Kadar Asam Traneksamat dalam Sediaan Farmasi. *Bandung Conference Series: Pharmacy*, *4*(2), 1031–1039. https://doi.org/10.29313/bcsp.v4i2.15571

Mukarromah I, Agnesia D, Rahma A. 2021. Pengaruh Substitusi Daun Kelor Dan Tulang Ikan Bandeng Terhadap Evaluasi Sensori Dan Kandungan Gizi Mie Instan. *Ghidza Media Jurnal*, *3*(1), 215. https://doi.org/10.30587/ghidzamediajurnal.v3i1.3085

Nurjadidah, Nazaruddin, Cicilia S. 2023. Pengaruh Suhu Dan Lama Pengeringan Terhadap Aktivitas Antioksidan Dan Mutu Teh Daun Jambu Biji Putih. *Edu Food: Jurnal Edukasi Pangan*, *1*(1), 55–67. https://journal.unram.ac.id/index.php/edufood/article/view/3641%0Ahttps://journal.unram.ac.id/index.php/edufood/article/download/3641/1828

Parhusip AJN, Hartono VC, Kristianto E, Fraulencia J. 2023. Peningkatan Kandungan Asam Amino Hidrolisat Tempe Semangit Melalui Penggunaan Enzim Protease dari Daun Kelor. *Jurnal Teknologi Pangan*, *17*(1), 89–106.

Rasyidi AF, Sulistiani R, Bin I. 2024. Kadar Klorofil Daun Bibit Kelor (*Moringa oleifera* L.) pada Berbagai Dosis Kompos. *AGRIUM: Jurnal Ilmu Pertanian*, *27*(1). https://doi.org/10.30596/agrium.v27i1.17486

Rizki WA, Nazaruddin N, Cicilia S. 2023. Pengaruh Rasio Bunga Rosella dan Daun Stevia terhadap Mutu Teh Rosella-Stevia. *Pro Food*, *9*(1), 89–99. https://doi.org/10.29303/profood.v9i1.321

Sadiah I, Indiarto R, Cahyana, Y. 2022. Karakteristik Dan Senyawa Fenolik Mikrokapsul Ekstrak Daun Kelor (*Moringa oleifera*) Dengan Kombinasi Maltodekstrin Dan Whey Protein Isolat. *Jurnal Teknologi Industri Pertanian 32*(3): 273-282. *https://doi.org/10.24961/j.tek.ind.pert.2022.32.3.273*

Viani TO. 2023. Formulasi Tepung Daun Kelor (*Moringa oleifera* L.) dan Tepung Terigu terhadap Mutu Sensori, Fisik, dan Kimia Cupcake. *Jurnal Agroindustri Berkelanjutan*, *2*(1), 147–160.

DOI 10.20884/1.jgipas.2025.9.2.18078