ABSTRACT / SHORT COMMUNICATION

Antioxidant, enzyme inhibitory, anti-diabetic properties of fatty acids isolated from seeds of *Vicia faba*

Piu Sasmal[1], Dr. Abha Kumari[2], Dr. Kamal Kant Patra[3]

[1]Piu Sasmal, Ph.D. Research Scholar, Department of Food & Nutrition, School of Science, YBN University, Ranchi
[2]Dr. Abha Kumari, Ph.D. Supervisor, Department of Food & Nutrition, School of Science, YBN University, Ranchi
[3]Dr. Kamal Kant Patra, Ph.D. Co-Supervisor, Department of Botany, School of Science, YBN University, Ranchi

ABSTRACT

Fatty acids isolated from the seeds of *Vicia faba* (broad beans) possess various health-promoting properties, including antioxidant, antimicrobial, and anti-diabetic effects. This research aimed to isolate and evaluate the health benefits of these fatty acids, which could offer natural alternatives for managing metabolic disorders and infections. The rationale for this study stemmed from the increasing global prevalence of chronic diseases such as diabetes and cardiovascular disorders, leading to a growing interest in natural bioactive compounds from plant sources. Fatty acids, known for their role in modulating oxidative stress, inhibiting pathogenic bacteria, and regulating enzyme activity, were explored for their therapeutic potential. This study provided valuable insights into the composition of fatty acids in *Vicia faba* and demonstrated their significant biological activities, contributing to the field of natural health remedies.

Key-word: *Vicia faba*, therapeutic potential, biological activities, various health-promoting properties

Introduction:

The genesis of this research lies in the increasing prevalence of lifestyle-related diseases, such as diabetes and cardiovascular ailments, which demand effective interventions. Over the years, there has been significant interest in plant-derived bioactive compounds due to their therapeutic benefits. *Vicia faba* seeds are rich in nutrients and bioactive compounds, particularly fatty acids, which are essential for human health. These fatty acids are known to play crucial roles in reducing oxidative stress, modulating lipid metabolism, and inhibiting microbial growth. However, their specific health-promoting properties have not been fully explored, particularly in terms of the therapeutic potential of fatty acids isolated from *Vicia faba* seeds.

The rationale behind this research was driven by the increasing burden of metabolic disorders and infectious diseases, prompting a need for novel, plant-based therapeutic agents. Fatty acids, with their established biological activities, could provide a natural, cost-effective approach to managing these health challenges. This study aimed to isolate and evaluate the health-promoting properties of fatty acids from *Vicia faba* seeds through in vitro assays, including antioxidant, antimicrobial, and enzyme inhibitory activities.

Review of Literature:

Fatty acids have long been recognized for their diverse biological functions. For instance, polyunsaturated fatty acids (PUFAs) such as linoleic acid and alpha-linolenic acid have shown strong antioxidant properties by neutralizing free radicals and reducing oxidative stress (Shahidi & Zhong, 2010). Studies have demonstrated the beneficial effects of omega-3 and omega-6 fatty acids in cardiovascular health, inflammation reduction, and neuroprotection (Simopoulos, 2002). These fatty acids, particularly when derived from plant sources, are known to exhibit fewer side effects than synthetic drugs.

Antimicrobial properties of fatty acids have also been widely reported. Research by Desbois and Smith (2010) indicated that medium-chain fatty acids inhibit the growth of both Gram-positive and Gram-negative bacteria. Fatty acids' mechanism of action involves disrupting the bacterial cell membrane, leading to cell death. Furthermore, enzyme inhibitory properties of plant-derived fatty acids have been explored for their potential in managing diabetes. Inhibition of key

digestive enzymes such as α-amylase and α-glucosidase, which regulate carbohydrate metabolism, has been observed in fatty acids from various plant sources (Ota & Ulrih, 2017). Despite this body of work, limited research has focused on the fatty acid profile of *Vicia faba* and its health-promoting properties, which provided the basis for this study.

Materials and Methods:

Vicia faba seeds were dried, ground into powder, and subjected to Soxhlet extraction to isolate fatty acids. The isolated fatty acids were analyzed using gas chromatography-mass spectrometry (GC-MS) to identify their composition. Antioxidant activity was measured using the DPPH radical scavenging assay, while antimicrobial activity was assessed against bacterial strains such as *Staphylococcus aureus* and *Escherichia coli* through the disc diffusion method. Enzyme inhibitory assays were conducted to evaluate the inhibition of α-amylase and α-glucosidase, which are associated with postprandial glucose control.

Results and Interpretation:

The GC-MS analysis revealed that the major fatty acids in *Vicia faba* seeds included linoleic acid (20.5%), oleic acid (17.3%), and palmitic acid (14.8%). These results aligned with the fatty acid composition of other legumes, reinforcing the idea that *Vicia faba* seeds are a rich source of bioactive fatty acids (Kadam et al., 2019).

Table 01: fatty acid composition, antioxidant, antimicrobial, and enzyme inhibitory activities of *Vicia faba* seed fatty acids:

Property	Types	Value
Fatty Acid Composition		
	Linoleic Acid	20.50%
	Oleic Acid	17.30%
	Palmitic Acid	14.80%
	Antioxidant Activity	
	IC50 Value	72.3 µg/mL
Antimicrobial Activity		
	Inhibition Zone (*Staphylococcus aureus*)	13.2 mm
	Inhibition Zone (*Escherichia coli*)	11.8 mm

Enzyme Inhibitory Activity		
	IC50 Value (α-amylase)	63.4 µg/mL
	IC50 Value (α-glucosidase)	51.2 µg/mL

In antioxidant assays, the isolated fatty acids demonstrated strong radical scavenging activity, with an IC50 value of 72.3 µg/mL. This result is comparable to standard antioxidants like vitamin C, which has an IC50 value in the range of 50–70 µg/mL (Shahidi & Zhong, 2010). The high antioxidant capacity of these fatty acids can be attributed to their ability to donate electrons and neutralize reactive oxygen species, thus preventing oxidative damage.

The antimicrobial activity tests showed that the isolated fatty acids exhibited moderate inhibition against *Staphylococcus aureus* and *Escherichia coli*, with inhibition zones measuring 13.2 mm and 11.8 mm, respectively. These results are in line with earlier studies, which demonstrated that fatty acids disrupt bacterial membranes, leading to growth inhibition (Desbois & Smith, 2010). The findings indicated that *Vicia faba* seed fatty acids could serve as natural antimicrobial agents, especially in combating Gram-positive bacteria.

In enzyme inhibitory assays, the fatty acids demonstrated significant inhibition of α-amylase (IC50 = 63.4 µg/mL) and α-glucosidase (IC50 = 51.2 µg/mL), suggesting their potential role in managing diabetes by controlling postprandial blood sugar levels. These values are comparable to those observed in synthetic enzyme inhibitors like acarbose, which have IC50 values around 50 µg/mL (Ota & Ulrih, 2017). The enzyme inhibition likely resulted from the fatty acids binding to the active sites of the enzymes, thereby preventing the breakdown of carbohydrates into glucose.

Outcomes:

The research demonstrated that fatty acids isolated from *Vicia faba* seeds possess significant health-promoting properties, including antioxidant, antimicrobial, and enzyme inhibitory activities. These properties highlight the potential of *Vicia faba* seed fatty acids as natural therapeutic agents for managing oxidative stress, infections, and metabolic disorders such as

diabetes. The study contributes to the growing interest in plant-based bioactive compounds and their potential applications in nutraceuticals and functional foods.

Conclusion:

In conclusion, this study successfully isolated and characterized the fatty acids from *Vicia faba* seeds and provided substantial evidence of their health-promoting properties. The fatty acids demonstrated strong antioxidant and enzyme inhibitory effects, making them promising candidates for natural therapies in managing oxidative stress and diabetes. Additionally, their moderate antimicrobial activity underscores their potential as natural antimicrobial agents. The findings of this research pave the way for future studies focusing on the in vivo efficacy of *Vicia faba* fatty acids and their application in the development of functional foods and nutraceuticals.

References:

1) Shahidi, F., & Zhong, Y. (2010). Lipid oxidation and improving the oxidative stability. *Chemical Society Reviews*, 39(11), 4067-4079.
2) Simopoulos, A. P. (2002). The importance of the omega-6/omega-3 fatty acid ratio in cardiovascular disease and other chronic diseases. *Experimental Biology and Medicine*, 226(6), 477-484.
3) Desbois, A. P., & Smith, V. J. (2010). Antibacterial free fatty acids: activities, mechanisms of action, and biotechnological potential. *Applied Microbiology and Biotechnology*, 85(6), 1629-1642.
4) Kadam, S. S., et al. (2019). Fatty acid composition of leguminous seeds and its biological significance. *Journal of Food Biochemistry*, 43(7), e12892.
5) Ota, A., & Ulrih, N. P. (2017). α-Amylase inhibitors: Mechanism of action, structural features, and industrial applications. *Food Chemistry*, 239, 403-415.