الجمهورية الجزائرية الديمقراطية الشعبية
وزارة التعليم العالي و البحث العلمي

University of Setif 1Ferhat ABBAS
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جامعة ، سطيف 1، فرحات عباس
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Université Ferhat ABBAS Sétif 1

DEPARTMENT OF BIOCHEMISTRY

N°...../SNV/2026

DISSERTATION

Presented by

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To obtain the diploma of

MASTER

Branch of study: Biochemistry

Specialty: Applied biochemistry

Applied Biochemistry Laboratory

THEME

Assessement of the Biological Effects of Food waste

Publicly supported on: **01/ 07/ 2026**

JURY:

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ACADEMIC YEAR: 20

Introduction

The continuous growth of the global population, rapid urbanization, and changing dietary habits have considerably increased the global demand for food. Consequently, food production and processing activities have expanded, leading to a significant increase in food waste generation throughout the food supply chain. Despite efforts to ensure food availability, a substantial proportion of food intended for human consumption is still lost or wasted **(FAO, 2011; FAO, 2014).**

Food waste (FW) has become a major global challenge affecting environmental sustainability, food security, and public health. According to the United Nations Environment Programme, approximately 1.05 billion tons of food waste were generated worldwide in 2022, with households representing the largest contributor (**UNEP, 2024**).

Food waste originates from various sources, including fruits, vegetables, cereals, dairy products, meat, fish, and agricultural residues (**Liu et *al*., 2023; Mia et *al*., 2025**). Owing to its rich organic composition, food waste contains numerous nutrients and bioactive compounds that may exhibit beneficial biological activities, particularly antioxidant, anti-inflammatory, antimicrobial, and other health-promoting effects (**Panda et *al*., 2025; Zamani et *al*., 2026).**

However, improper management of food waste may also promote the growth of pathogenic microorganisms and the formation of harmful compounds, including mycotoxins, endotoxins, and biogenic amines, thereby posing potential risks to human health and environmental safety (**Fayyaz et *al*., 2022; Fontaine et *al*., 2026**). In addition, food waste contributes to greenhouse gas emissions, resource depletion, water pollution, and soil degradation (**Marimuthu et *al*., 2024**).

Therefore, sustainable management and valorization strategies have become increasingly important. Biological treatments such as composting, anaerobic digestion, fermentation, and vermicomposting can convert food waste into valuable products, including bioactive compounds, biofuels, animal feed, and organic fertilizers (**Packiyadhas et *al*., 2025**). Within the framework of the circular economy, food waste is increasingly considered a valuable resource rather than merely a waste product (**Bandara et *al*., 2026**).

Therefore, the present work aims to evaluate both the beneficial and adverse biological effects associated with food waste, with particular emphasis on its composition, biological activities,

microbiological risks, and valorization potential. Understanding these aspects may contribute to the development of sustainable strategies for food waste management and its conversion into valuable biological resources.

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الملخص

تمثل النفايات الغذائية تحديًا بيئيًا وصحيًا عالميًا، إذ تؤدي إلى استنزاف الموارد الطبيعية وتساهم في تلوث البيئة، مع ذلك فإنها تُعد مصدرًا مهمًا للمركبات النشطة حيويًا ذات التأثيرات البيولوجية المفيدة . تهدف هذه الدراسة إلى تقييم التأثيرات البيولوجية للنفايات الغذائية من خلال دراسة تركيبها، وتأثيراتها الإيجابية والسلبية، وطرق تثمينها. تحتوي النفايات الغذائية على مركبات مثل المركبات الفينولية والكاروتينات والفيتامينات ومضادات الأكسدة التي تمتلك خصائص مضادة للأكسدة والالتهابات، وفي المقابل، قد يؤدي سوء إدارة هذه النفايات إلى التلوث الميكروبي وإنتاج السموم والتلوث البيئي.تساهم استراتيجيات الإدارة المستدامة، مثل التسميد العضوي والهضم اللاهوائي وإنتاج الطاقة الحيوية، في تقليل الآثار البيئية وتحويل النفايات الغذائية إلى منتجات ذات قيمة مضافة.

الكلمات المفتاحية: النفايات الغذائية، ضياع المواد الغذائية، التأثيرات البيولوجية، المركبات النشطة حيويًا، التثمين.

Abstract

Food waste represents a major environmental and health challenge worldwide. It leads to the loss of natural resources and contributes to environmental pollution. However, food waste also contains valuable bioactive compounds with important biological activities. This work aims to assess the biological effects of food waste by studying its composition, beneficial effects, adverse impacts, and valorization methods. Food waste contains compounds such as phenolics, carotenoids, vitamins, and antioxidants that exhibit antioxidant, anti-inflammatory, and health-promoting properties. Conversely, improper management of food waste may cause microbial contamination, toxin production, and environmental pollution. Sustainable management strategies, including composting, anaerobic digestion, and bioenergy production, can reduce environmental impacts and convert food waste into valuable products. Therefore, food waste should be considered both an environmental issue and a potential biological resource.

Keywords: Food waste, Food loss, biological effects, bioactive compounds, valorization.

Résumé

Les déchets alimentaires représentent un défi environnemental et sanitaire majeur à l'échelle mondiale. Ils entraînent une perte importante des ressources naturelles et contribuent à la pollution de l'environnement. Cependant, ils constituent également une source importante de composés bioactifs présentant des activités biologiques intéressantes. Ce travail vise à évaluer les effets biologiques des déchets alimentaires en étudiant leur composition, leurs effets bénéfiques, leurs impacts négatifs et leurs méthodes de valorisation. Les déchets alimentaires contiennent des composés tels que les composés phénoliques, les caroténoïdes, les vitamines et les antioxydants, qui présentent des propriétés antioxydantes et anti-inflammatoires. À l'inverse, une mauvaise gestion des déchets alimentaires peut favoriser la contamination microbienne, la production de toxines et la pollution environnementale. Des stratégies de gestion durable telles que le compostage, la digestion anaérobie et la production de bioénergie permettent de réduire les impacts environnementaux et de transformer les déchets alimentaires en produits à valeur ajoutée.

Mots-clés : Déchets alimentaires, effets biologiques, composés bioactifs, Pertes alimentaires, valorisation.