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AN ANALYSIS STUDY OF SOME AGRICULTURAL WASTES AND THEIR IMPACT ON THE ENVIRONMENT

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Abstract

Globally agricultural production systems generate large amounts of solid wastes. One of major causes of environmental pollution is agri-plant waste, which is not properly disposed. As a result, pollution problems and its impact on human health increase. Hence, there is a need to get rid of them through chemistry intervention and convert them into energy in an environmentally friendly way. Therefore this study aimed to shed light on this vital topic in an attempt to analyze agri-waste, and identify their environmental impacts. Analytical chemistry is key to achieving this goal. Detailed elemental analyses Na, K, Ca, P, Mg, Sr, Fe, Mn, Ni, Co, Cr, Cu, Se, Zn, As, Pb, Hg, and Cd, moisture content, ash content, volatile matter, and calculated fixed were performed. Rapid analytical methodologies such as microwave digestion, and ICP-MS were used. The findings of this investigation showed that the levels of elements in the plants under study were higher than the lower limit allowed by the FAO. In addition to the level of moisture, ash, and volatile matter, as well as the level of elements were in parallel allowing them to act as catalysts Ca, and K when converting waste to energy through thermochemical. In addition to the level of toxic element as with the present Ni release compound, it is suggested that the study results are more environmentally friendly.

Keywords: Biomass waste, Agricultural waste, Environmental impact, Pollution.

دراسة تحليلية لبعض المخلفات الزراعية وأثرها على البيئة

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الخلاصة

تولد أنظمة الإنتاج الزراعي العالمية كميات كبيرة من النفايات الصلبة. أحد الأسباب الرئيسية للتلوث البيئي هو نفايات النباتات الزراعية، والتي لا يتم التخلص منها بشكل صحيح. ونتيجة لذلك تزداد مشاكل التلوث وتأثيره على صحة الإنسان. وبالتالي، هناك حاجة للتخلص منها من خلال التدخل الكيميائي وتحويلها إلى طاقة بطريقة صديقة للبيئة. لذلك هدفت هذه الدراسة إلى إلقاء الضوء على هذا الموضوع الحيوي في محاولة لتحليل المخلفات الزراعية، والتعرف على آثارها البيئية. الكيمياء التحليلية هي المفتاح لتحقيق هذا الهدف. تم إجراء تحليلات عنصرية مفصلة Na وK وCa وP وMg وSr وFe وMn وNi وCo وCr وCu وSe وZn وAs وPb وHg وCd ومحتوى الرطوبة ومحتوى الرماد والمواد المتطايرة والحساب الثابت. تم استخدام منهجيات تحليلية سريعة مثل الهضم بالموجات الدقيقة وICP-MS. أظهرت نتائج هذا التحقيق أن مستويات العناصر في النباتات قيد الدراسة كانت أعلى من الحد الأدنى المسموح به من قبل منظمة الأغذية والزراعة. بالإضافة إلى مستوى الرطوبة، والرماد، والمواد المتطايرة، وكذلك مستوى العناصر بالتوازي مما يسمح لها بالعمل كمحفزات Ca وK عند تحويل النفايات إلى طاقة من خلال الكيمياء الحرارية بالإضافة إلى مستوى العنصر السام As مع وجود عنصر يمكن إطلاق مركبات صديقة للبيئة لذلك نقترح ان نتائج الدراسة أكثر صداقة للبيئة.

كلمات مفتاحية: نفايات الكتلة الحيوية، النفايات الزراعية، تأثيرها البيئي، تلوث.

Introduction

Agricultural waste can be collected from diverse sources as follows: first field waste of plant origin (crop waste) and second field waste of animal origin (animal waste) (12). In addition, agricultural waste has different faces such as solid, liquid and gaseous emissions (26). As argued by (11) agricultural waste consists of inorganic, and organic, that are produced in a farm through various farming activities such as, breeding livestock, harvesting crops, horticulture, processing dairy farming, and seed sowing. As previously mentioned the vast majority of agricultural waste is produced from different materials. Thus, it is the second largest contributor to global warming (greenhouse gas) in the environment 19.9% as shown in Figure 1 (9). The burning of waste causes environmental and human health problems and poses threats to food and energy security (16).

Numerous studies have examined the impact of biomass waste or Agricultural Waste on Sustainable Environment (1, 21, 33 and 36) however, analysis of the characterization of these wastes, and the level of some metal (13, 14 and 19) have been less investigated. Therefore, it is important to address the aforementioned issues prior to placing an effective and efficient scheme for impeding and/or limiting the negative effects of the presence of metal (loid)s contaminants in biomass waste.

Analytical chemistry is a key, and basic step in many sciences and can be performed by scientists and engineers who are not chemists. Analytical chemistry plays a crucial role in many fields, such as energy, medicine, food, material sciences, geology and pharmaceuticals. Recently, analytical chemistry has dominated the use of alternative energy, and analysis of biomass waste (10). Numerous analytical procedures have been used to analyze plants, and soil using different methods such as spectrofluorometric (31) c, HPLC (25), GC/MS (18), CFI (5), X-ray (28), microwave digestion (17), and ICP-MS (32).

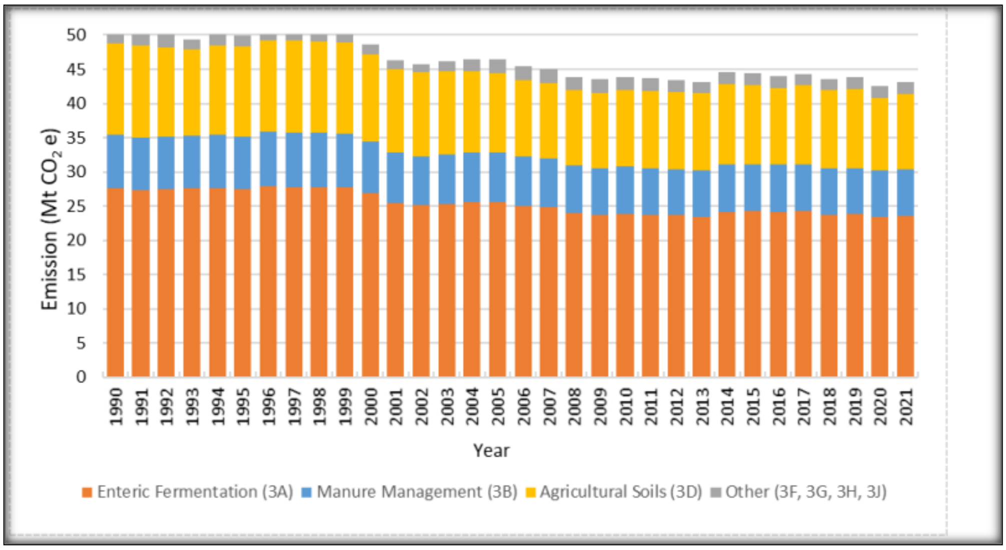

Figure 1 Total Global Warming Potential weighted emissions in the Agriculture sector (9).

The acid catalyst concentration and type as well as the methods of systematic mixing with the order of addition, play the main role in achieving significant degradation of cellular structures of the biomass waste plant, regardless of the type of heating method (17). Four types of acids (hydrochloric, nitric, sulfuric, and per chloric) or mixing (6) and/ or mixing of nitric acid and hydrogen peroxide (15) are sometimes used to decompose biomass waste plants and prepare them for elemental determination. The present study analyzed heavy metal concentrations in the leaves of two plant species each with 15 samples, which were collected from a highway passing through the Al-Khadra neighborhood in Baghdad city, Iraq, where concentrations of heavy metals are expected to be significantly high as a result of contamination from smoke from local electric generators, cars and factories in this area. Different heating temperatures, with different types of ovens were used to study the moisture, ash, and volatile matter content. Microwave digestion was conducted by mixing nitric acid and hydrogen peroxide to estimate the concentrations of the elements in the sample using ICP-MS.

Materials and Methods

Collection of the biomass waste plant: In this study, 30 samples of two types of Malva arborea (Mb), and berpine (B) were collected from areas 25 cm away (at 9 am/ October 2022) because they were expected to be significantly high as a result of contamination from the smoke of local electric generators as well as cars and factories in this area from a highway passing through the Al-Khadra neighborhood in Baghdad city, Iraq.

Preparation of the biomass waste plant: The sample preparation procedure included washing, drying, and grinding. Each sample was washed with tap water to remove dirt, sand, and other physical contaminants followed by air-drying. Thereafter, the sample was further dried in an oven at 40 °C ± 5 °C for one hour, after which the biomass waste plant was grinded into a fine powder (15).

Characterization of the biomass waste plant: Each analysis was performed in triplicate, yielding a total of 660 analyses, for all samples. Values are presented as the mean M, standard deviation STD, and RSD.

Moisture: The moisture content (7) of each waste plant was then calculated. The methods can be relied on gravimetric analytical chemistry with the principle of weight loss for volatile water (2) for that oven for drying at 105°C for 24 hours was used. The moisture content (%) was calculated using Eq. 1.

$$\textit{Moisture Content}, w(\%) = \frac{M_w}{M_D} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$\textit{Where}, \quad M_w = \textit{mass of water}$

$M_d = \textit{dry mass of sample}$

Ash values: So as to type of oven use in this part is muffle furnace at 600-6500°C for 6 hours (24). The ash content (%) was determined using Eq. 2.

$$\textit{Ash Content}, Ash(\%) = \frac{Ash_r}{D_{PS}} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$\textit{Where}, \quad Ash_r = \textit{weights of ash residue}$

$D_{PS} = \textit{dry plant sample}$

Volatile matter values: The volatile matter content (23) in each biomass waste plant was calculated. The heated of dry sample up to 950°C for 7 minutes. The final product was weighed after cooling it in a desiccator for at least 80 minutes. The volatile matter content (%) was calculated using Eq. 3.

$$\textit{Volatile matterContent}, w(\%) = \frac{W_d - W_f}{W_d} \times 100 \ldots\ldots (3)$$

$\textit{Where}, \quad W_d = \textit{weights of dry sample}$

$W_f = \textit{weights of final sample}$

Metal (loid)s extraction and analysis: The elemental concentrations in biomass waste plant are usually determined by applying a digestion procedure. Microwave digestion was performed using mixture of nitric acid (HNO_3) and hydrogen peroxide (H_2O_2)

(15). ICP-MS (Perkin Elmer types NexION350D) was used to measure the concertation of the dissolved elements Na, K, Ca, P, Mg, Sr, Fe, Mn ,Ni, Co, Cr, Cu, Se, Zn, As, Pb, Hg, and Cd ,The ICP-MS was calibrated with standard solutions for each element (32). The concentration of each element $\boldsymbol{C_E}$ was calculated using Eq. 4.

$$C_E\left({}^{\mu g}/_{kg}\right) = \frac{C_{s-}C_b}{m_d} \times 100 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4)$$

Where, C_s = *concentrations in sample extract*$(\mu g/L)$
C_b = *concentrations in blank extract*$(\mu g/L)$
m_d = *dmass of sample* (g)

Results and Discussion

The results of moisture, ash, and volatile matter analysis of the biomass waste plant samples are given in Table 1 and Figure 2, which show a low level of moisture of less than 25%, Ash level of less than 10%,and volatility of less than 55%, which are the most significant contributors to identifying, the type of conversion energy. Therefore, thermochemical can be used (20), because in this method the product of fuel will be higher and have higher efficiencies (30). In addition, the results revealed, that these types of biomass waste plant (Malva arborea, and Berpine) are more environmentally friendly (8), because this sample releases less CO, and CO_2 based on the percentage of these contents (27).

Table 1 Moisture, ash, and volatile matter content in biomass waste plant samples (Malva arborea, and Berpine).

			Malva arborea			Berpine	
Property	**Unit**	**Mean value**	**Std dev**	**%RSD ***	**Mean value**	**Std dev**	**%RSD ***
Moisture content	wt. %(ar)	28.754	0.134	0.346	21.53	0.05	0.120
Ash content	wt. %(dry)	8.2278	0.0.7	0.851	7.382	0.35	4.741
Volatile matter	wt. %(dry)	52.6143	0.219	0.416	50.453	0.219	0.434
***RSD= (STD⁄M)×100**							

The concentrations of the two types of elements (Malva arborea, and Berpine) in biomass waste plant, summarised in Figure 3, Figure 4, and Figure 5. Each data point is expressed as the mean concentration (mg/kg (dry)).

The mean concentrations of Na, K, Ca, P, Mg, Sr, Fe, and Mn are shown in Figure 3. The chart shows significantly higher concentrations of Ca> P> Mg> Fe> K> Mn> Sr> Na, in descending order, which is in agreement with the data of a previous study (14). In addition to the concentration of these elements, it is environmentally friendly, because Ca and K can be considered as internal catalysts (29 and 34).

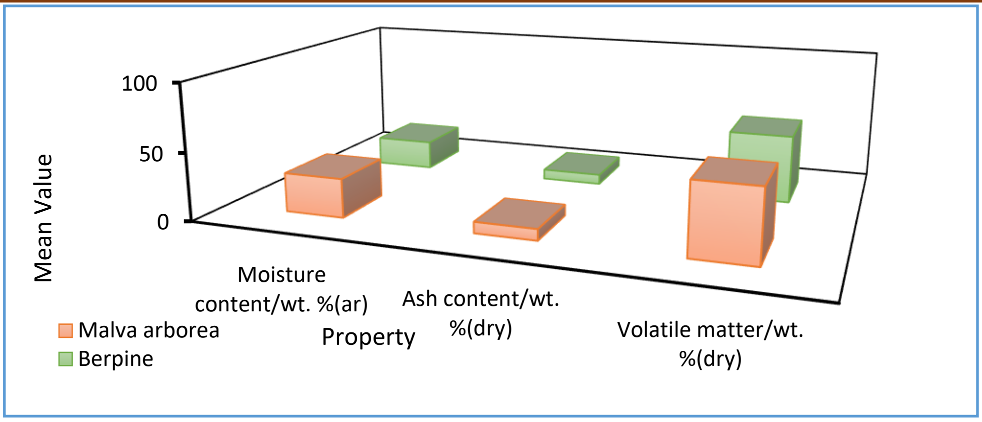

Figure 2 Biomass waste plant samples (Malva arborea, and Berpine) content Moisture, ash, and volatile matter.

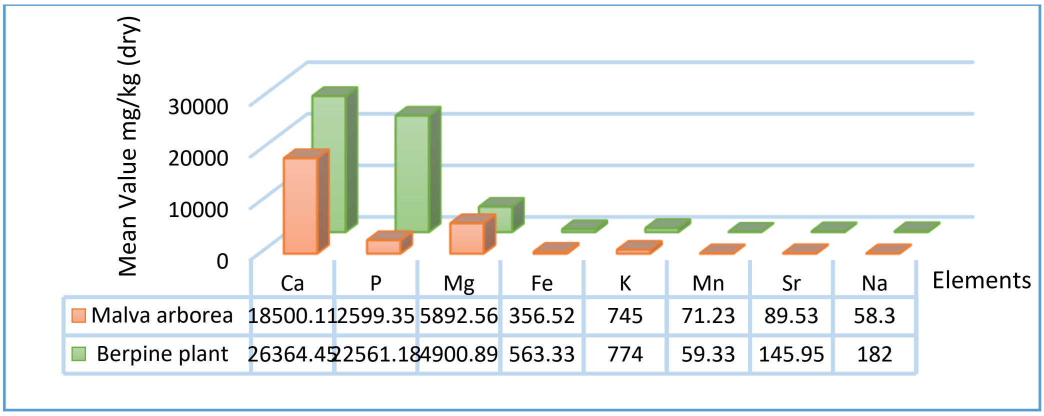

Figure 3 The mean concentration (mg/kg (dry) of Ca, P, Mg, Fe, K, Mn, Sr, and Na in biomass waste plant samples ((Malva arborea, and Berpine).

As mentioned in previous studies (14) There are no "Iraqi guidelines standardize the concentration of metals in leafy vegetables" and, the results from the FAO/WHO permissible levels in leafy vegetables (14, 22 and 35) were adopted for comparison result as shown in Figure 4, and Figure 5.

Figure4 shows summarized the level of element Ni, Co, Cr, Cu, Se, and Zn, mean concentration (mg/kg (dry)). These results are within permissible levels, when compared to the results from the FAO/WHO permissible levels in leafy vegetables, therefore this level of concentration of these elements is environmentally friendly.

On the other hand, the results show that toxic elements such As, Pb, Hg, Cd, and Si are present in biomass waste plant samples (Malva arborea, and Berpine), which exceeded the permissible limits recommended by the FAO/WHO as can see in Figure 5. These results are consistent with the hypothesis set for this study, because the samples were contaminated with smoke from local electric generators, cars and factories.

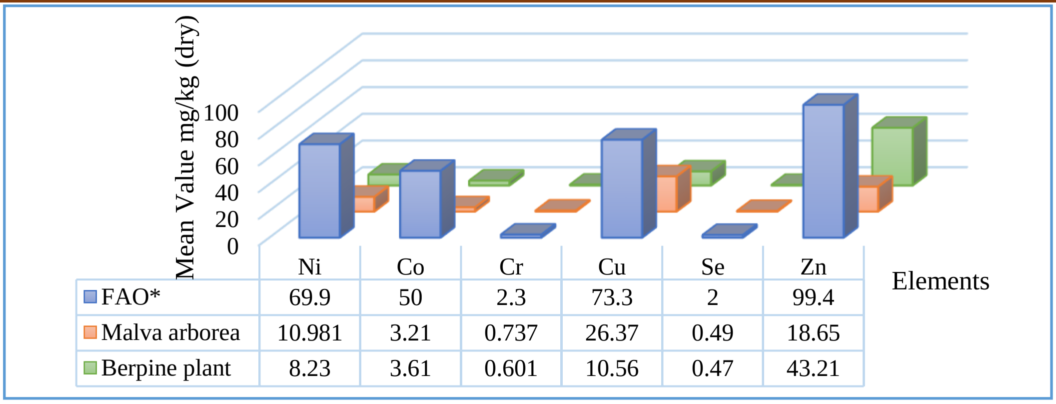

Figure 4 The mean concentration (mg/kg (dry) of Ni, Co, Cr, Cu, Se, and Zn, in biomass waste plant samples ((Malva arborea, and Berpine).

*"FAO/WHO Permissible levels in leafy vegetables" (14, 22 and 35).

However the level of toxic element As around (0.25 and 0.2543 mg/kg (dry) found in biomass waste plant samples with the level of element Ni approximately 10.981, and 8.23 mg/kg (dry) gives good an opportunity to form compounds As_2Ni_3 and As_8Ni_{11} (3 and 4), When used samples to convert to energy, and thus become these samples environmentally friendly.

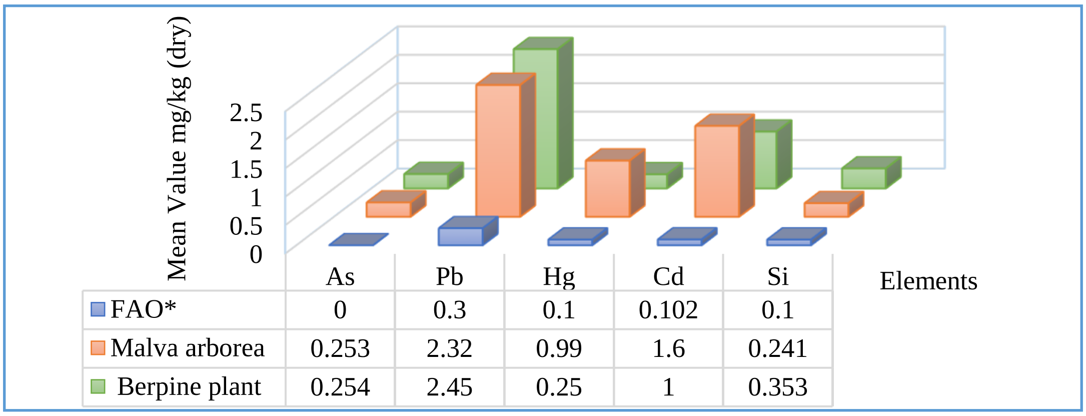

Figure 5 The mean concentration (mg/kg (dry) of Ni, Co, Cr, Cu, Se, and Zn, in biomass waste plant samples ((Malva arborea, and Berpine).

*"FAO/WHO Permissible levels in leafy vegetables" (14, 22 and 35).

Conclusion: Removing biomass waste plant from contaminated places that pollute via different types can significantly increase public health, and environmental concerns. In this study moisture, ash, volatile matter, and elements present were measured in two types of biomass waste plant collected from areas 25 cm away from a highway passing through the Al-Khadra neighborhood in Baghdad city, Iraq. The estimation of moisture, ash, and volatile matter yields lower values. This result opens the way to using biomass waste plant removed from the contamination site in Iraq, energy production by thermochemical such as gasification and/or combustion. In addition, the estimation of elements with these levels provides an opportunity to utilize this type of biomass waste plant in the conversion of clean energy. Therefore, the results obtained in this study are considered to be the first evidence to be present in Iraq. This is an environment-friendly biomass waste plant.

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