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# Identification of nanomaterials from agricultural waste based Microstructural analysis

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Abstract: In the current situation, the most important environmental pollutants are derived from the combustion process of grown agricultural waste; during this process, a greater number of toxins are released directly into the atmosphere. Therefore, it has been shown that the use of these wastes results in a more beneficial product that may be utilised in geotechnical engineering applications. The nanosilica that is recovered from grown agricultural waste is the principal product that is obtained. It is possible to utilise it as a supplement for the purpose of stabilising soft soils and enhancing the mechanical qualities of problematic soils, as well as for the purpose of increasing the strength of concrete while maintaining its durability features, polymer composites, insect control, and biomedical applications. Using microstructural analysis as a basis, this work investigates the identification of nanomaterials derived from agricultural wastes that have been farmed. Once the oxides of materials have been identified, it will be simple to extract nanomaterials using a variety of different techniques. Microstructural study, on the other hand, demonstrated that there were more oxides, nanosized, amphorous forms, and symmetrical linkages than formerly thought.

Keywords: Cultivated agricultural waste, nanomaterials, Microstructural analysis, Nanotechnology, methodology

Introduction:

The cultivated agricultural wastes (CAW) are comprised of bioactive compounds that are used as a source for the production of various goods, including composite materials [1,2], fillers [3,4], adsorbents [5-7], extra cement materials [8,9], and silica-based products [10-14]. The goods lower the costs of manufacturing and the amount of pollution that is released into the environment [15-17]. There are many different types of cultivated agricultural wastes that may be used to extract nanosilica from CAW. Some examples of these residues are bagasse, bamboo, breadfruit tree, cane, coffee, rice husk, rice straw, sorghum, wheat, Sorghum Vulgare seed heads (SVSH), humus-rice husk, cucumber, strawberry, and palm oil grounds. As an additional point of interest, the cultivated wastes include the field end process of crop harvesting, which includes everything from leaves and stalks to seed pods and stems [18].

A significant contribution to the global economy was made by the cultivation of rice harvest culture, which produced about 1370 million tonnes (Mt) of rice annually in 2021 from the agricultural sector, resulting in 342.1 million tonnes of rice husk from rice processing [19]. The rice milling business, on the other hand, is plagued by issues such as the possibility of fire, the need of any additional space that is not essential, and the fact that burning generates ecological difficulties with by-products such as rice husk. Rice cultivation resulted in the production of 2890 million tonnes of rice straw annually [20]. In 2013, V. B. Carmona and colleagues suggested a leaching process for rice husk, which is an efficient way for eliminating metallic elements and superfluous impurities. This approach involves boiling rice straw and soaking it in acid combinations while applying pressure to the mixtures in order to increase the amount of silica content in the final product [21].

For the purpose of extracting silica, the SVSH, which has a high concentration of silica, may also be used as a raw material that is economically feasible. There is a widespread cultivation of Sorghum Vulgare, and the grains that it produces are used in the creation of alcoholic drinks as well as flatbreads, which are the primary source of nutrition for a great number of civilizations. Consequently, it is a significant food crop and ranks as the fifth most significant cereal crop that is farmed on a worldwide scale.

There is a significant quantity of grains present in SVSH. It is considered waste to remove the seed heads after the grains have been removed. The average annual output of SVSH is between 66 and 75 Mt due to the fact that a key food crop is responsible for the creation of flatbreads that are utilised in alcoholic drinks and cereal kinds of the crop across the globe [22].
The quality and quantity of nanosilica is depend on extraction methodologies such as; calcination methodology with acid solutions [21], biological treatment like worms digestion methodology [23], surface modification with amino acids [24], precipitation methodology [25,26], sol–gel process [27], microwave heating at 800 W for 10mins [28], acid precipitation process (APP) [29], fluidized bed under velocity [30], and leaching process [31], and digestion by nitric acid [32]. As a result, nanosilica is utilised in a wide variety of applications, including but not limited to the following: stabilising agents in all structures related to civil engineering [33-35,58], rubber, ceramics, paints, and chemical industries [36,37], food-related industries [38], biomedical applications [39-41], cancer treatment bone tissue, and dental applications [42], biosensors, nano sensors [43,44], and water retention capacity [45,49].
The purpose of this work is to provide a description of the prior research that has been conducted on the extraction techniques of nanosilica from grown agricultural waste, namely rice husk, SVSH, and rice straw ash, all of which are environmental pollutants of significant importance. After that, the results were characterised by the use of microstructural analysis, and a comparison was made using characteristics such as the percentages of nanosilica, nanosized, amphorous shape, greatest silica content, and more symmetrical links between silicon and oxygen.

This study examines the detection of nanoparticles obtained from agricultural waste by the investigation of their microstructure. After identifying the oxides of materials, extracting nanomaterials may be easily accomplished using a range of approaches. The microstructural research revealed the presence of a greater number of nanosized oxides, amorphous forms, and symmetrical connections than previously believed.
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## 2. Experimental works

### 2.1 Samples preparation for MSA

Based on MSA, the identification of nanomaterials from a variety of the CAWs that were gathered were the following: CAWs, such as rice husk ash (RHA), green grams ash (GGA), black grammes ash (BGA), red grammes ash (RGA), coconut palms ash (CoPA), and groundnut seed pods ash (GNPA). In order to eliminate any extraneous contaminants, for get more content of specified oxides. After dried at 80°C, grinding with 900W capacity grinder for 5-10mins. The grinded powder sieved though 75microns IS sieve.

## 3. To Select best oxides of nanomaterials from CAW’s on EDAX test

Among all the wastes that include a larger percentage of oxides and are used in the production of nanomaterials that has a higher percentage to begin with. Before being burnt for eight hours at a temperature of 800 degrees Celsius until powder is generated, these wastes are cleansed with deionized, distilled warm water to eliminate any substances that are not necessary. The metal and acidic elements that have collected on the rice husk grains are removed after they have been washed and soaked in warm water for a period of two hours. Because of this, the silica concentration of the rice husk is higher than that of the flowing top part. Drying the settled rice husk grains at 80 degrees Celsius for twenty-four hours is done before processing. Additionally, the findings of the microstructural investigation may be of use in determining the most appropriate approach, such as EDAX, SEM images, or XRD. The grinded and sieved powders kept in muffle furnace for 8-10hrs at 800-820°C until get color change. After about 95% of the organic content that is left behind in the waste is exposed to the environment, completely all CAWs transform into amorphous forms. After get residue cool and do EDAX test for results of oxides then easy to select nanomaterials from CAW’s. The following EDAX profiles are shown in the figures: 1 (a) RHA, 1 (b) GGA, 2 (a) BGA, 2 (b) RGA, 3 (a) CoPA, and 3 (b) GNA.

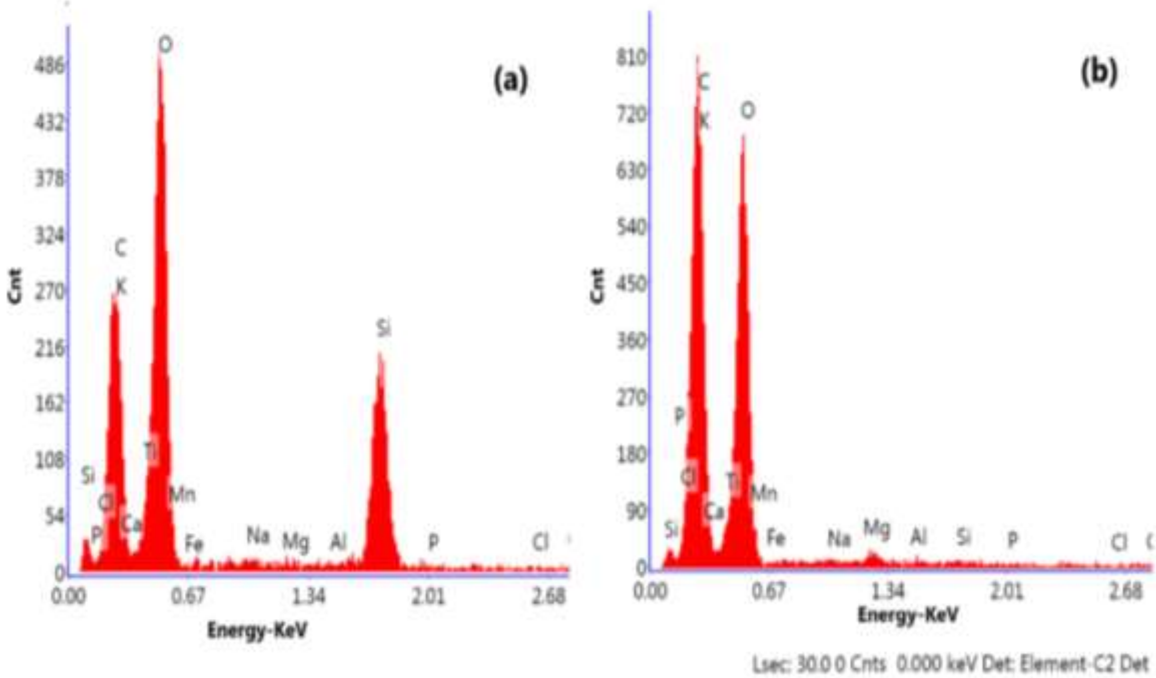


Fig. 1 EDAX profiles of a) RHA and b) GGA

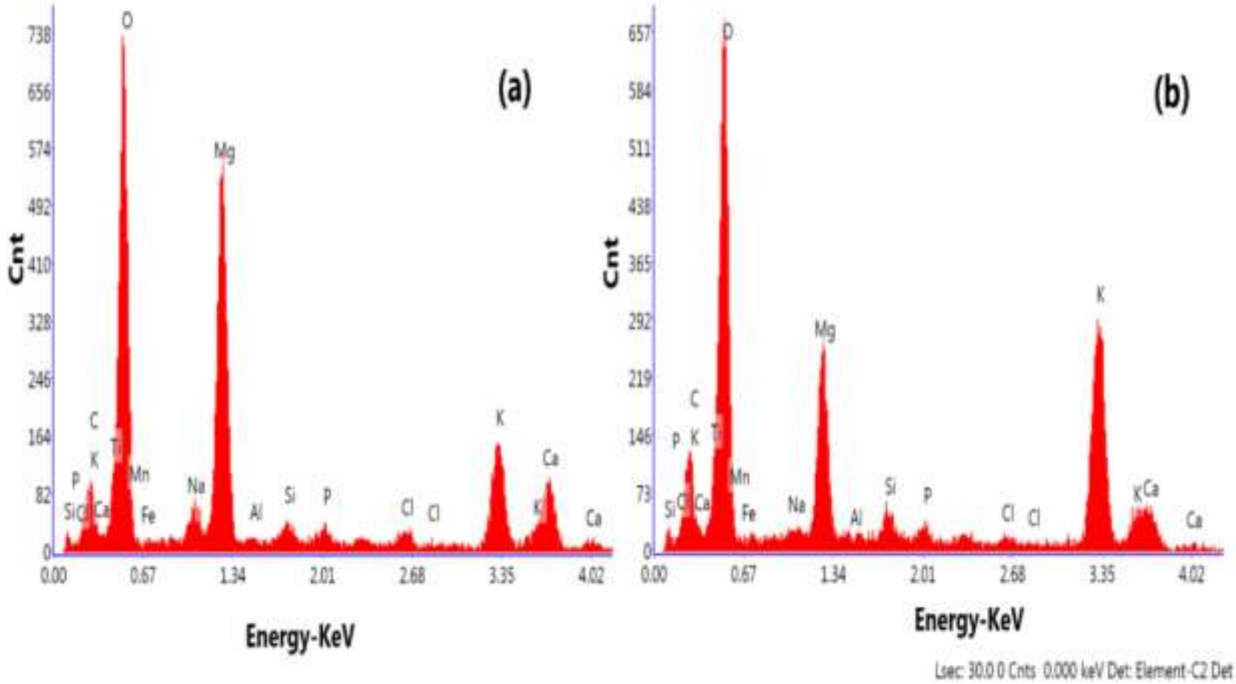


Fig. 2 EDAX profiles of a) BGA and b) RGA

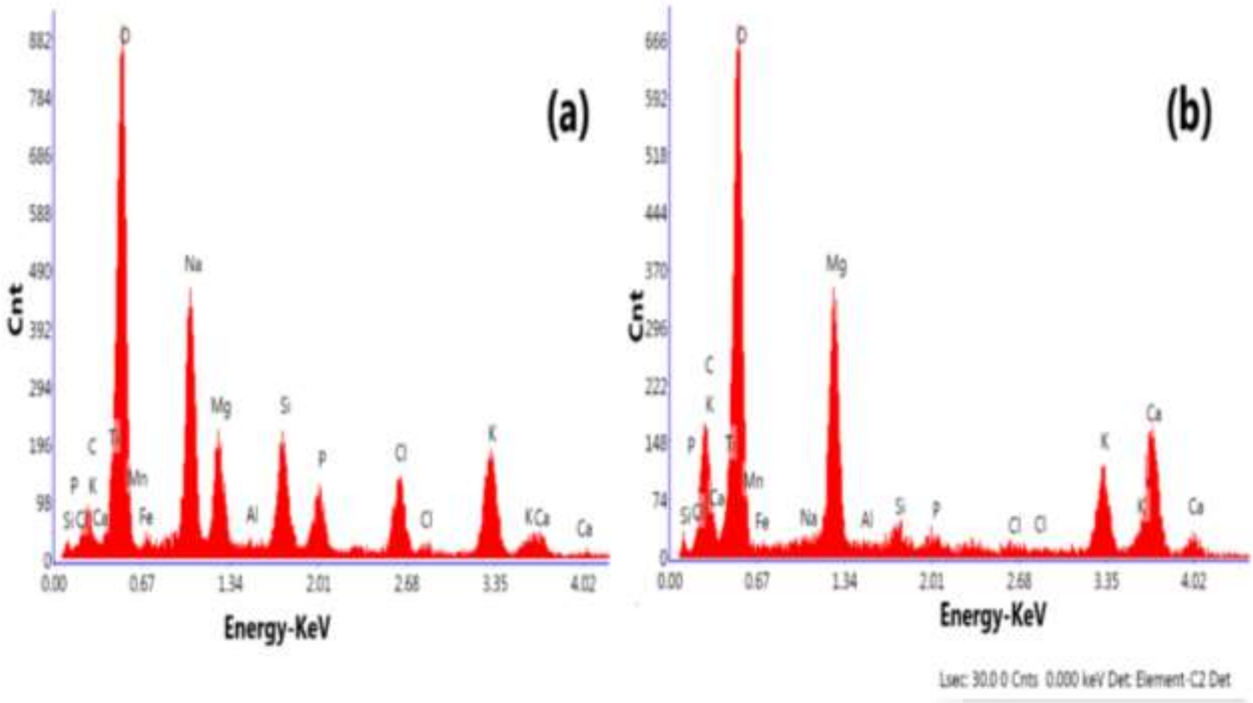


Fig. 3 EDAX profiles of a) CoPA and b) GNA

RH has a larger percentage of SiO2 (39.47%) and C (29.5%), whereas CoP has a higher percentage of SiO2 (20.67%) and Na2O (20.68%), GGP has a higher percentage of C (40.1%), BGP has a higher percentage of CaO (26.9%), and GNP has a higher percentage of CaO (27.5%). These findings are based on the findings of the study. All of the EDAX test results show that RH and CoP have a larger proportion of SiO2, with RH having a higher percentage than CoP. Additionally, RH contains 29.6% of carbon material. It will not be difficult to eliminate the C by the process of incineration. When compared to CO, COP contains a larger proportion of Na2O, which is more difficult to eliminate than CO; yet, CO is easier to remove.

## 4. Discussion

Based on results:
1) RHA, CoPA are to be used for extraction of nanosilica because of both have more silica content.
2) Carbon can be extracted from RHA and GGA.
3) Calcium Oxide can be extracted from BGA and RGA.
4) Magnesium Oxide can be extracted from BGA.

These agicultutal wastes used for directly extracted respected materials, and depend on extraction methodologies such as; calcination methodology with acid solutions [21], biological treatment like worms digestion methodology [23], surface modification with amino acids [24], precipitation methodology [25,26], sol–gel process [27], microwave heating at 800 W for 10mins [28], acid precipitation process (APP) [29], fluidized bed under velocity [30], and leaching process [31], and digestion by nitric acid [32]. As a result, nanomaterials are utilised in a wide variety of applications, including but not limited to the following: stabilising agents in all structures related to civil engineering [33-35,58], rubber, ceramics, paints, and chemical industries [36,37], food-related industries [38], biomedical applications [39-41], cancer treatment bone tissue, and dental applications [42], biosensors, nano sensors [43,44], and water retention capacity [45].

## 5. Conclusions

Among the CAWs that were gathered were the following: CAWs, such as rice husk ash (RHA), green grams ash (GGA), black grammes ash (BGA), red grammes ash (RGA), coconut palms ash (CoPA), and groundnut seed pods ash (GNPA). RH has more SiO2 (39.47%) and C (29.5%), whereas CoP has more SiO2 (20.67%) and Na2O (20.68%), GGP has more C (40.1%), BGP has more CaO (26.9%), and GNP has more CaO (27.5%). Study results underpin these conclusions. All EDAX tests reveal that RH and CoP contain more SiO2, with RH having more. Additionally, RH has 29.6% carbon. Incineration can easily remove C. COP has more Na2O than CO, making it harder to remove. RHA and CoPA are going to be employed for the extraction of nanosilica since both of these substances have a higher silica concentration, according to the findings. The RHA and GGA both have the potential to yield carbon. An extraction of calcium oxide may be made from both BGA and RGA. As a by-product of BGA, magnesium oxide may be manufactured.

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