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Retraction

Retracted: Nanomaterials for Food and Agriculture in Economic Valuation of the Technology Harvesting Maize Straw for Biogas Production in China

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

1. Discrepancies in scope
2. Discrepancies in the description of the research reported
3. Discrepancies between the availability of data and the research described
4. Inappropriate citations
5. Incoherent, meaningless and/or irrelevant content included in the article
6. Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Z. Fan, "Nanomaterials for Food and Agriculture in Economic Valuation of the Technology Harvesting Maize Straw for Biogas Production in China," *Journal of Nanomaterials*, vol. 2022, Article ID 9029863, 8 pages, 2022.

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Research Article

Nanomaterials for Food and Agriculture in Economic Valuation of the Technology Harvesting Maize Straw for Biogas Production in China

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Maize has a tremendous open door, immensely as a biofuel source. The objective reason for this examination is to break down the capacity of maize straw procured under fluctuating climatic circumstances to be used in biogas handling and the effect on different physicochemical components, for the most part, outstandingly the dry mass substance. This information indicates that corn stalks collected in China and Eastern Europe may exhibit extensive dry matter synthesis. This may be related to prewinter climate change. Regardless of temperature or consistency, corn straws can make incredible (for damp materials) or sublime (for more powdered straws) biogas substrates. With a new mass of methane value of 201207 m^3/mg, this material is a much better substrate than the corn silage (about 105 m^3/mg FM) which is definitely used in Europe. Corn straws were said to require longer consideration (3642 days) than corn silage (not exactly 30 days). In any case, this distinction is not important, and the biogas plant can remind the manager.

1. Introduction

Among the most endemic products generated in agronomy is maize straw (also known as crop Residues). However, particularly in China, the use of this fabric has been limited. Its use was confined to cutting during harvesting and subsequent sloughing for most landowners. Among the considerations to consider while harvesting crop wastes for commercial biodiesel are forestalling soil disintegration, rationing soil natural matter, and keeping up with or further developing computerization. As of late, worldwide maize grain creation extended by around 40%, showing up at very nearly 1100 million tons. In 2017, the EU made more than 70 million tons of maize grain, while in 2012 alone, 1.20 million tons of maize straw were brought to Beijing for appraisal, with more than 2.7 108 tons passed yearly all on through China (Wandera, et al., [1]). As a result of the speedy speed of grain creation, crop stores like leaves, stalks, husks, and cobs of whole maize plants can account for up to half of the dry matter yield. The parts referred to as of late changed in regards to substance creation, improvement, and fiber attributes, as well as gathering times and even geography or soil type. For instance, adequate capacity because of ensiling tasks empowers 1.1%-2.2% decreased loss of natural matter contrasted within outside capacity (63.1%).

1.1. Maize Straw Direct Combustion. Direct burning is one strategy for extricating energy from maize straw. The calorific value of corn straw is 17.65 to 18.6 MJ/kg dry matter. This is the all-out esteem doled out without respect for the degree of individual parts, their age, dampness content, or combination. The gross energy variety of unmistakable straw divisions all through development was very assorted. The incongruities were even half in specific ludicrous models. It is underlined that such huge varieties in values were brought about by test heterogeneity or perhaps an absence of consistency in calorimetric frameworks, informing the acknowledgment with respect to mean quality somewhere within a scope of 16.7 to 20.9 MJ/kg. Also, they spread out the energy content of different maize parts, guaranteeing that it stays

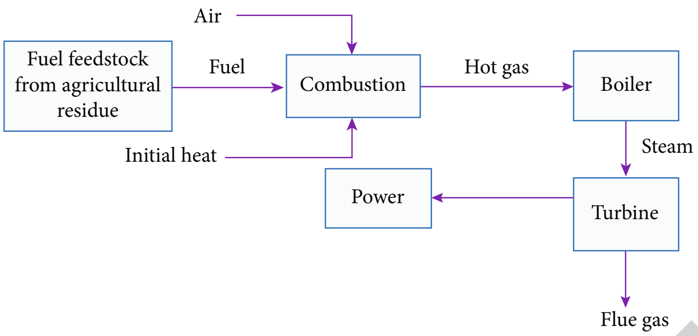


Figure 1: Direct combustion of maize straw.

unsurprising. After a timeframe and between individual plants, they contend that, because of utilization, there is no essential capability with respect to division and the second at which the plants were secured (Sun, et al., [2]). While seeing maize straw blended in with other biomass animates, thought ought to likewise be given to garbage containing between 4% and 6.8% silica (especially with a silica concentration of over 34% and potassium concentrations greater than 30%) is a significant amount of NO_2 (0.6 percent N), sulfur (0.09 percent S), and chlorine (0.36 percent Cl). These are basically beneficial qualities in contrast with premium wood pellets ought to have under 0.3 percent nitrogen, 0.05 percent sulfur, and 0.03 percent chlorine.

Figure 1 is direct combustion of maize straw.

1.2. Bioethanol Production. Another technique for using the energy contained in corn straw is the further development of bioethanol [3]. Biotransformation of maize stalks has long been a firm idea, as this improvement adversely affects the climate and is abundant and economical [4, 5]. Worries about maize straw expulsion recommended that an absolute necessity be kept on the field to safeguard the dirt's humic substance and usefulness, and that there may likewise be supply and dissemination limits [6]. Anyway, corn straws provide both financial and environmental safety for producing bioethanol as a gas option.

Figure 2 is production of bioethanol.

Maize straw, as a generally common lignocellulose unrefined substance, includes lignin, cellulose, and hemicellulose structure, a perplexing polymer structure that keeps reaction media or proteins from getting into private contact with cellulose, and maize straw is attempting to push toward bioethanol production [7–9]. It has a low mass and energy thickness, is impenetrable to corruption, and requires pretreatment when utilized on quiet targets (Czajkowski, Wojcieszak, Olek, and Przybył, [6]). Simultaneous chopping and coprogress have been considered for the production of cellulosic ethanol, but this idea is misdefined because both chopping and coprogressing are incompatible [10]. Lignin is inert and requires additional mixing during the enzymatic hydrolysis of cellulosic degradation followed by the production of ethanol, as well as consuming additional reactor space. This surprisingly disappoints the high solids of lignocellulosic biomass and ethanol storage, eliminating other sources of energy while expanding the energy expected for ethanol purification and ethanol transport, interfering with the production of cellulosic ethanol.

Figure 3 is production of cellulosic ethanol.

1.3. Potential for Economic and Power Generation. For the most part, the expense of agrarian deposits USD 1-8 GJ can be estimated for European settings. There are significant differences in the possibilities and costs of biomass production throughout Europe's 280 regions (NUTS2). Areas of great potential and low cost are integrated into key parts of Poland, the Baltic states, Romania, Bulgaria, and Ukraine. France, Spain, and Italy all have attractive average policies in Western Europe, offering a wide range of opportunities at low cost. Consuming corn in a warmer has been demonstrated to be equipped for uprooting a lot of petroleum derivative currently expected to dry maize grain at a variety of areas (Morissette, Savoie, & Villeneuve, [11]). Studies have shown that using a corn stover as the basic energy source for grain drying has a limited 8.9 mg/h dryer with a reliable heating capacity of 0.7 MW and a heating power suitable for constant power: suitable for both huge 73 mg/h dryers 6.3 MW [12]. As indicated by similar producers, confined scope drying would have a 14-year recompense span at USD 25 mg/DM (dry matter) and gather ship costs, and, surprisingly, 8 years, assuming it was dried at greater costs like USD 45 mg/DM (because of higher vehicle expenses to the objective) because of a reasonable effect of the scale impact.

Figure 4 is potential for economic and power generation.

1.4. Production of Biogas. About 20,000 biogas jobs are working in Europe. With the exception of Denmark, Switzerland, and Sweden, the most complex substrate for today's biogas plants is corn silage, which is supplied throughout crop aging. This substrate maintains constant biogas production (about 105 m3 CH4/mg fresh weight) and is very easy to connect and store. Due to the serious consistency of the various EU subformulas, this substrate remains highly profitable in most plant biogas offices, despite its enormous cost (Barten, [13]) that provided ample because for the meteoric rise in maize production for biogas plants in districts such as Germany, silage production

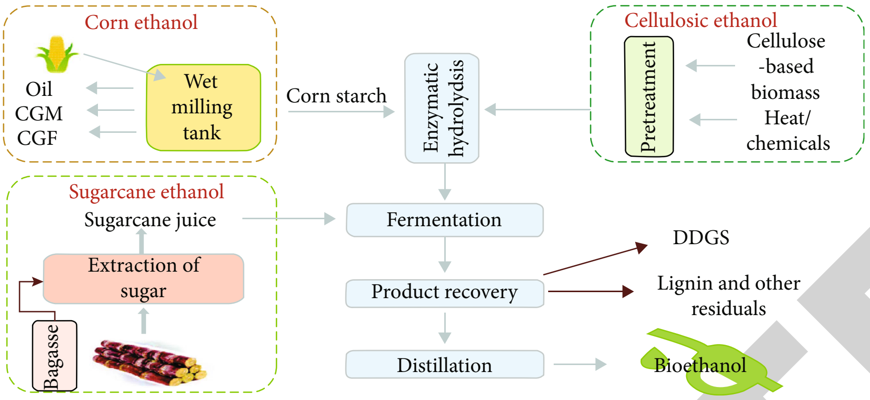


Figure 2: Production of bioethanol.

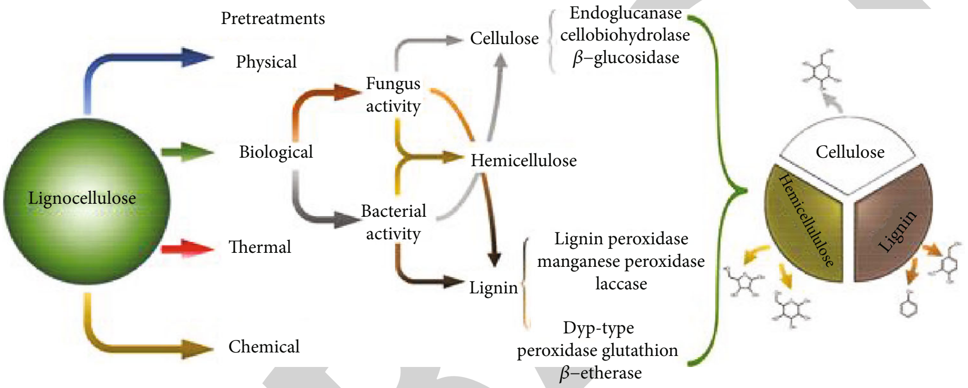


Figure 3: Production of cellulosic ethanol.

Figure 4: Potential for economic and power generation.

accounts for more than 10% of the nation's land surface area requirements.

In any event, numerous European governments have set limits on their renewable energy source endowments throughout the last decade. This also had an effect on the biogas sector. On the other hand, maize silage costs increased significantly, reducing the rentability of biogas plants. To that purpose, numerous biogas plant administrators began looking for alternative substrates that are easy to obtain, affordable, and produce a high amount of methane. It is one of these substrates, as confirmed by Chinese authorities.

Figure 5 is biogas productions.

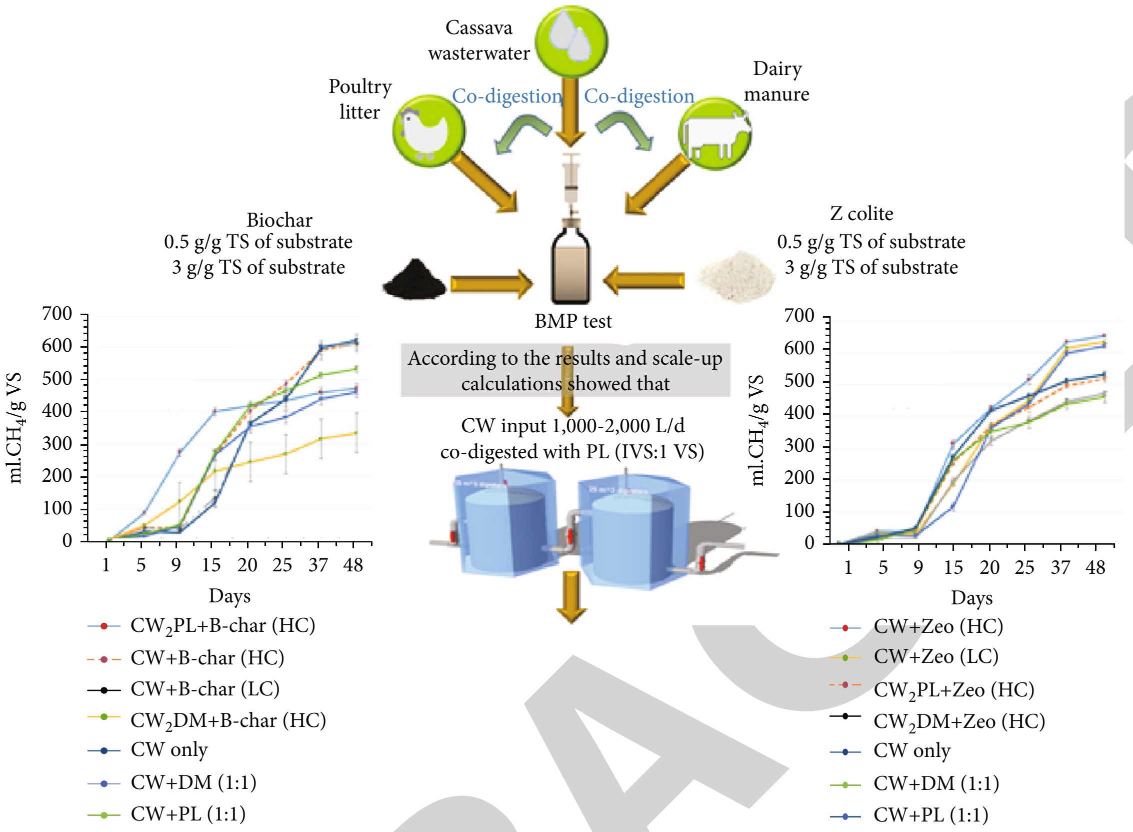
2. Review of Literature

Kythreotou et al. reviewed the various models of anaerobic digestion used for understanding the process and operation of the anaerobic digester. The ADM1 is the comprehensive model, but it is complicated. So, the simpler calculators are developed by him which will not be used for simulation but can be used to estimate the applicability of process for a specific farm. This model is easy to use for farmers and decision-makers to get the required information.

By varying the ratio of domestic garbage to weeds, we were able to determine the biogas generation rate. It was discovered that the production rate varies with the ratio and reaches its highest when the ratio is maintained at 50-50%.

Anaerobic digestion is a promising technology for food waste disposal and gives the highest gas production compared to any other waste inputs [3]. Kujawa et al. [14] performed the comparison of unscreened dairy manure and food waste experimentally. Result showed that the gas yield is more with food waste.

Browne et al. played out the analysis to examine the impacts of capacity time and capacity temperature on biogas production. The storage time was kept between 1 and 26 weeks prior to digestion, and the temperature of the slurry was kept 90°C and 200°C. There was no effect of 90°C temperature for 26 weeks on biogas production. However, at 200°C temperature, the biogas production starts increasing



- The system could produce 9,403 m^3 CH$_4$/yr equivalent to 373,327 MJ/yr or 24.9 tons of firewood/year.
- The system would have a profit of \$5,642/yr and \$47,805 net present value.

FIGURE 5: Biogas productions.

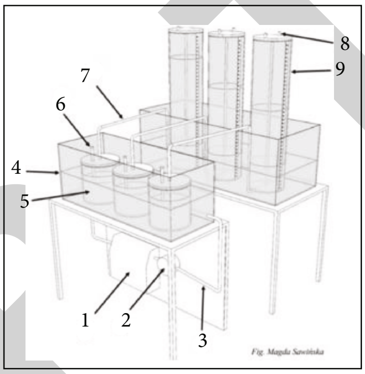


FIGURE 6: Fermenter schematic structure for biogas research (3 room area): water heater with temperature control, water siphon, and 3 safe child-forming liquid aids. 4 water jackets, 5 fermenters with a capacity of 2 dm^3, 6 test tubes, 7 biogas transport pipes, 8 gas survey valves, and 9 biogas volume balanced supplies.

TABLE 1: The initial limit of the test material (corn stalk) used for aging.

Substrate	TS (% FM)	VS (% TS)
MS45	44.2	13.1
MS44	79.1	44.3
MS72	46.2	10.2
MS66	44.6	46.3

after eight weeks, and it shows that the gas productions start decreasing after 26 days.

The efficiency of biogas technology depends on various physical conditions too. Czekała et al. [5] developed three-stage methane fermentation anaerobic digester to digest food waste and examined the temperature and hydraulic retention time (HRT) effect on the digestion process. The temperature was maintained in the range of 30°C to 55°C, and the hydraulic retention time (HRT) was 8 to 12 days. The results of thermophile digesters with respect to total biogas and methane production were better than hemophilic digesters. Comparatively, maximum biogas production resulted at ten days of HRT.

Fabregat et al. played out a test under mesophilic and thermophilic conditions. The sewage muck was processed with marine and freshwater microalgae species, viz., Isochrysis galbana and Selenastrum capricornutum individually. He saw the impact of temperature and substrate on biogas creation. The similar aftereffect of biogas creation under thermophilic and mesophylic condition was 566 ± 5 mL

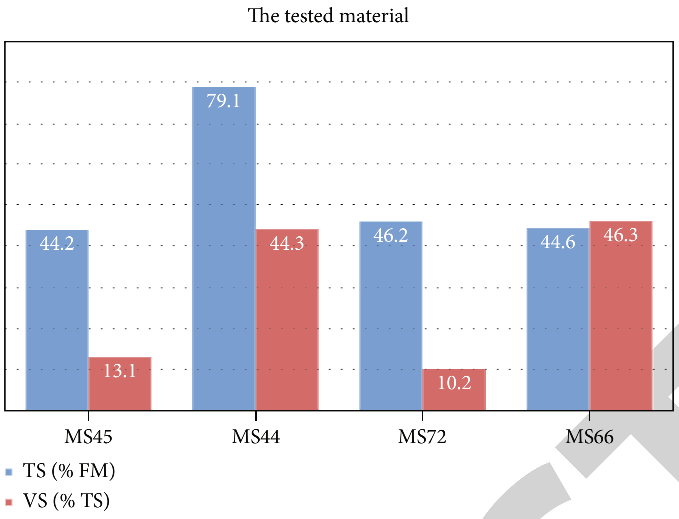


Figure 7: Tested materials (maize straws) used for fermentation.

biogas/gvs and 451 ± 12 mL biogas/gvs separately. The outcome showed that more measure of biogas was created under thermophilic conditions than the mesophylic condition. The impact of above-said types of microalgae was additionally considered, and it was noticed that 440 ± 25 mL biogas/gvs was delivered because of the option of Isochrysis galbana and in the event of Selenastrum capricornutum species; it was 271 ± 6 mL biogas/gv.

3. Materials and Methods

Evaluation materials (some types of corn stalks) were obtained from four facilities in western and eastern Poland. Straw was collected directly from the field after grain harvesting (about 10 kg for each model) and sent to the Ecotechnology Institute (Posnan University of Life Sciences, PULS) for important and advanced research in biogas production. Straw was exposed to various atmospheric conditions that would affect the overall actual properties (Wi’sniewski, et al., [15]).

The amassed materials (different maize straws) were assembled by their dry matter substance. To that objective, material undertakings (every maize straw, MS) unite how much dry matter was accessible (TS). MS45, MS55, MS78, and MS89 were viewed as straws (numbers allude to the fundamental dry matter), and substance is communicated in view of the level of dry matter.

3.1. Physical Analysis. The dry matter composition of maize samples was initially determined (complete solids-TS, as indicated by Clean PN-75 C-04616/01 standard). The standard connection includes 24-hour drying tests (three times) at 105°C. According to PN-Z-15011-3, the regular matter (volatile solids, VS) is still hanging out there after 3 hours of consumption of dry models (in three emphases). Additionally, it is the pH (PN-90 C-04540/01) and conductivity of the briefly introduced (PN-EN 27888: 1999).

Information on TS and VS shall be collected to initiate further development tests on demand and to initiate the achievability of methane and biogas production for each straw variety in m^3/mg FM (fresh weight) units and is ideal to emphasize M3/mg TS and m^3/mg VS (Wilhelm, Johnson, Karlen, and Lightle, [12]). While the CH4 production in m^3 per VS is habitually utilized in fixation on scatterings to examine the feasibility of different substrates, the most principal evaluation in genuine world biogas plant improvement is the substrate methane utility communicated in CH4 by mg of FM (fresh matter).

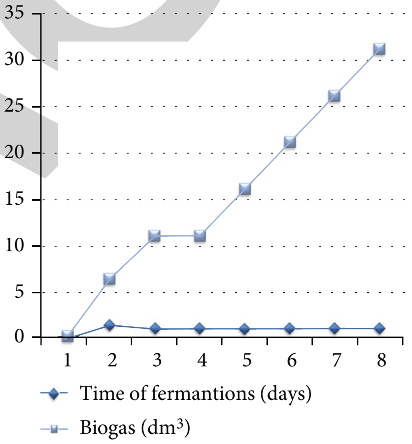


Figure 8: Production of biogas during material aging cycle (everyday estimations) for all materials.

3.2. Methane Fermentation Experiments. The examination of biogas took place at Ecotechnologies Laboratory, Poland’s largest biogas facility. The lab operates according to the German guidelines DIN 38 414/S8 and VDI 4630. This research facility was granted by the Proficiency Test Biogas certification and was declared in 2017 as a component of a progression of worldwide tests coordinated by the German KTBL, as it was the primary Polish biogas lab to do great examination on methane maturation (Das, Peterson, & Chin, [16]). The anaerobic assimilation of straw samples

Table 2: The creation of biogas and methane from various materials.

Substrate	CH4	CH4 content	Biogas m^3	CH m^3	Biogas mg TS	Ch4	Biogas m^4
MS45	48.3	10.35	79.5	123.5	795.2	48.3	10.35
MS44	46.3	1.34	79.22	79.6	46.3	46.3	1.34
MS66	45.1	46.2	795.2	10.35	468.2	45.1	46.2
MS70	77.2	73.1	46.3	1.34	46.3	1.34	79.22

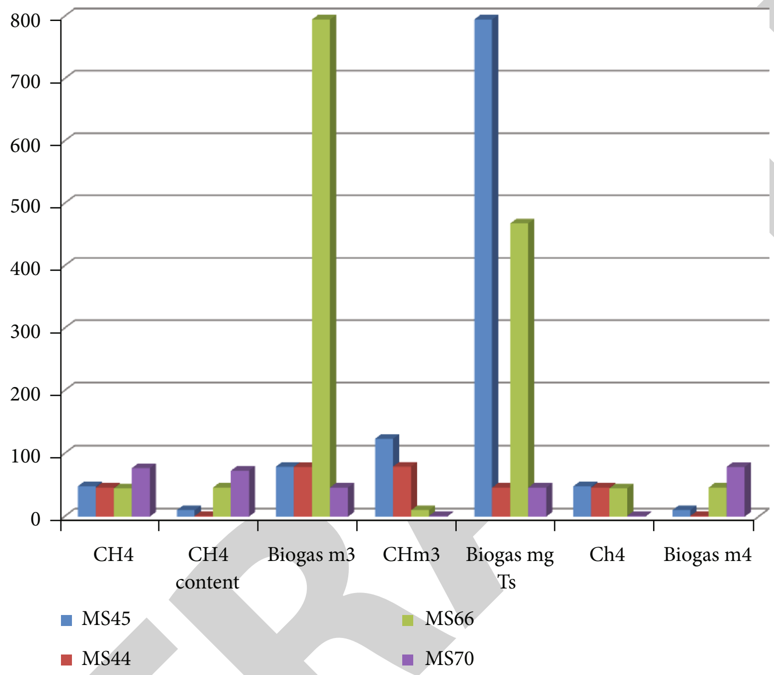


Figure 9: Methane production during aging cycle (day to day estimations) for all materials.

was carried out in a specialized 21-chamber fermenter. Figure 6 illustrates a simplified form of a three-chamber section fermenter.

At the point when the time of customary biogas was under 1% of the absolute volume of obtained biogas, the examination was shut (within the DIN 38 414/S8 standard). The biogas and methane productivities of the materials inspected might be depicted as low, extraordinary, or amazing (Morales, Quintero, Conejeros, & Aroca, [17]). This action is used in the communicated investigation to assess the engineered energy creation from maize straw and is given as how much methane conveyed per (m^3 CH4/mg) is a mass unit. Since corn silage with a methane value of 105 m^3/mg is the most commonly used substrate in European biogas plants, all straws are modeled as “poor substrate” and “variable substrate” (corn silage, etc.) and are classified according to “generally superior substrates.”

4. Result

4.1. Physical Analysis. Table 1 shows the results of the dry matter (TS) and natural dry matter (VS) surveys.

Figure 7 is tested materials (maize straws) used for fermentation.

The study of TS reveals a substantial variance in the dry matter content of the tested materials, which ranges from 45 to 89 percent. This enormous discrepancy is due to the highly variable meteorological conditions (varying precipitation and temperatures) in fall in Poland, which fundamentally affects the achievability capacity arrangements for maize straw. It should be emphasized that maize straw can be used in place of more dry materials, such as MS78 and MS89 and put away when squashed (bunches) (Zabed, Sahu, Boyce, & Faruq, [18]). Nonetheless, materials with a higher dampness content, like MS45 and MS55, ought to be put away as silage for a more drawn out timeframe, as extra trial of wet straw stockpiling in parcel increment in their temperature and start semifertilizing the soil cycle. This peculiarity fundamentally diminishes the energy capability of maize straw by allowing heat to escape uncontrollably from worm bundles.

4.2. Fermentation Results. Figure 8 illustrates the outcomes of biogas production. It is critical to emphasize that the findings of biogas creation (detailed in dm^3) cannot be straightforwardly analyzed among tried materials now because of the shifted introductory new mass utilized in the testing. The German standard DIN 38 414/S8 expects that the

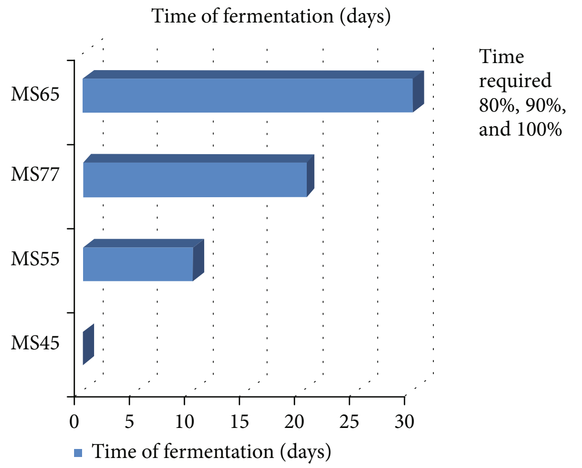


Figure 10: It took 80%, 90%, and 100% of the total methane production from the corn stovers surveyed.

example volume be assessed in natural dry matter (VS), and that implies that the underlying measure of new matter is regularly unique. The last figures for biogas and methane usefulness (as determined as per the DIN standard) are accounted for in Table 2.

The biogas usefulness test reveals that the cycle produced the most gas during the preceding ten days. The development times for three of the materials studied were almost unknown (36-37 days); yet, the driest straw (MS89) required 42 days. This was without a doubt because of the greatest centralization of scarcely fermentable fibers, which might be the subject of future research (Wojcieszak, Przybył, Mazurkiewicz, Janczak, & Zaborowicz, [19]).

Figure 9 depicts the methane production results.

It is critical to emphasize that methane (found in biogas) is the critical metric for estimating substrates. The biogas is primarily composed of methane (which serves as the cogeneration unit's fuel) and carbon dioxide (the stabilizer). As with biogas production, the majority of methane were produced within the initial 10-13 days. After the twentieth day, methane yields to remain low across the tried board.

Figures in Table 2 show that the methane fixations in totally tried materials were moderately comparable (around 49-50 percent). The CH4 creation from concentrated on material changed essentially (from 99 to 207 m^3/mg) in the estimation utilizing new matter, albeit this is normal given that a higher dry matter fixation relates with expanded methane creation (Haseli, [20]). A normal maize silage produced using total plants can produce approximately 105 m^3/mg of methane. The productivity of wet straws (MS45 and MS55) is slightly lower than that of maize silage but nearly doubles when more dry straws are used.

From the perspective of a biogas plant manager, the time required for total substrate fermentation is critical since a shorter biogas production process allows for the treatment of more substrate in fermenters of a similar volume. The time expected for complete aging, as well concerning levels of methane generation of 80% and 90%, is depicted in Figure 10.

5. Conclusion

Based on a detailed review of this white paper, we made the following decisions:

(1) Corn stalks collected in Central and Eastern Europe may exhibit various dry matter syntheses associated with turbulent cooling in early winter

(2) Regardless of moisture content, corn straw can be the optimum substrate (for damp materials) or exceptional substrate (for drier straws) in biogas plants (Womac, Igathinathane, Sokhansanj and Pordesimo, [21]). Due to the advantages of another bulk material, 201-207 m^3/mg methane, this material is clearly superior to the corn silage (about 105 m^3/mg FM) which is commonly used in Europe

(3) Maize straw requires more thought than maize silage (36-42 days) (under 30 days). Regardless, this separation is unneeded and can be accomplished through the biogas plant administrators [22–26]

Simulation is essential to simulate a baseline biogas digester for three total solid (TS) concentrations: 2.5 percentage, 5.4 percent, and 7.5 percent. For three distinct TS concentrations, the maximum area speeds seen are in the spectrum of 1.0-1.1 m/s, while the highest surface velocities measured are 0.0005 m/s-0.0230 m/s. With a rise in TS intensity, the mixing in the digester diminishes

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The author declares no conflicts of interest.

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