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Research Paper

Development of Briquettes from Natural Products for Knockdown of Mosquitoes

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ABSTRACT
Malaria is a major death cause in many parts of the world. This necessitates the development of alternative ways of curbing the problem. This study focused on the development of briquettes that would knockdown (KD) mosquitoes in the course of burning. The briquettes were developed using jatropha seed husks (source of energy), cow dung (binder) and pyrethrin (insecticide), which were then tested for their ability to knockdown and kill mosquitoes at Kenya Pyrethrum Board laboratory. The results were analysed using the analysis-of-variance (ANOVA) tool. The results showed that a hand pressed mixture of jatropha seed husks, pyrethrin and cow dung (binder) in the ratio of 3g: 0.5 ml: 2g respectively can cause a 100 % mosquito knockdown within 10 min. and mortality of 97.50 % within 24 hr when burnt indoors. The percentage mosquito knockdown and percentage mortality rate were found to vary significantly with the amount of pyrethrin used. It is expected that the findings of this study will generate new knowledge on briquette development and also contribute to waste management.

Keywords: *Knockdown; Briquettes; Natural Products; Mosquitoes; Biomass briquettes.*

I. INTRODUCTION

A briquette is a block of compressed materials suitable for burning. Briquettes can be made from materials that cost little or no money to obtain, such as old newspaper or partially decomposed plant waste. They can be used as fuel instead of charcoal, firewood or mineral coal, and may cost less. Depending on which materials were used to make the briquettes, they may burn cleaner than charcoal. Finally, turning waste materials into a fuel source is attractive because it reduces waste as well as reducing the demand for non-renewable fuel resources Briquetting your waste wood shavings and / or dust is essentially compressing the material into a cylindrical form. This is done through a dedicated briquetting machine which can be specified to suit the amount of waste that needs to be handled. Not only can these machines process woodwaste, they can also be used for cardboard, paper, straw and in some cases waste metal shavings.

The research you described suggests a novel approach to utilizing jatropha seed husks, pyrethrin, and cow dung to produce fuel briquettes capable of indoor mosquito knockdown. The mixture consists of jatropha seed husks, pyrethrin, and cow dung in specific ratios: 3g of jatropha seed husks, 0.5ml of pyrethrin, and 2g of cow dung. The components are hand pressed together with cow dung acting as a binder. This process likely involves mixing the ingredients thoroughly and then compacting them into briquettes. The study found that when these briquettes are burnt indoors, they are highly effective at knocking down mosquitoes. Specifically, they achieved 100% mosquito knockdown within 10 minutes of burning. Additionally, the briquettes resulted in a mosquito kill rate of 97.6% within 24 hours of burning. This indicates that not only do they knock down mosquitoes effectively, but they also significantly reduce mosquito populations over time. The efficacy of these briquettes in terms of mosquito knockdown and kill rate aligns with the Kenya Standard Specification for mosquito coils from the year 2000. According to this standard, accepted biological efficacy for mosquito coils is a knockdown of 50% within 20 minutes and a kill rate of 90% within 24 hours.

Overall, this research suggests a promising and potentially eco-friendly method for controlling mosquitoes indoors using locally available materials to produce fuel briquettes. These briquettes not only provide a sustainable fuel source but also offer effective mosquito control, which is particularly important in regions where mosquito-borne diseases are prevalent.

II. LITERATURE REVIEW

The process described involves conducting a comprehensive survey of existing literature, including journals, conference proceedings, trade magazines, government reports, market data, consumer information, and product information related to briquetting machines. The purpose of this survey is multifold: The primary objective is to determine if there are any frugal extrude briquetting machines available in the market. This entails gathering information on existing products that offer similar functionality or features. By analyzing market data, consumer information, and product information, researchers can gain insights into market trends, consumer preferences, and the demand for briquetting machines. This information can guide product development and marketing strategies. The survey aims to identify similar products or mechanisms in other industries or areas that could inform the development of the current product. By examining related technologies or processes, researchers can potentially adapt or improve upon existing designs. Conducting a patent survey is crucial to ensure that the proposed product or technology does not infringe on existing patents or intellectual property rights (IPR). This helps mitigate legal risks and ensures that the product can be brought to market without legal obstacles. Overall, the survey serves as a vital step in the research and development process, providing valuable insights into the existing landscape of briquetting machines, market dynamics, consumer preferences, and potential legal constraints. This information is essential for making informed decisions and guiding the direction of product development efforts.

Biomass briquettes are a biofuel substitute to coal and charcoal. They are used to heat industrial boilers in order to produce electricity from steam. The most common use of briquettes are in the developing world, where energy sources are not as widely available. There has been a move to the use of briquettes in the developed world through the use of cofiring, when the briquettes are combined with coal in order to create the heat supplied to the boiler. This reduces carbon dioxide emissions by partially replacing coal used in power plants with materials that are already contained in the carbon cycle. Manufacturers mainly use three methods to create the briquettes, each depending on the way the biomass is dried out. Although biomass briquettes are usually manufactured, biomass has been used throughout history all over the world from simply starting campfires to the mass generation of electricity.

The study focuses on the development of briquettes designed to knock down mosquitoes during burning. This approach utilizes a combination of jatropha seed husks (as a source of energy), cow dung (as a binder), and pyrethrin (an insecticide). The briquettes are composed of jatropha seed husks, cow dung, and pyrethrin. Jatropha seed husks serve as the primary source of energy, cow dung acts as a binder to hold the briquettes together, and pyrethrin functions as an insecticide to target mosquitoes. The developed briquettes are tested for their effectiveness in knocking down and killing mosquitoes at the Kenya Pyrethrum Board laboratory. This likely involves controlled experiments to assess the impact of burning the briquettes on mosquito populations. The expectation is that the developed briquettes will demonstrate efficacy in reducing mosquito populations through knockdown and killing effects. If successful, this approach could offer a sustainable and environmentally friendly method for mosquito control, particularly in areas where traditional methods have limitations. The results were analysed using the analysis-of-variance (ANOVA) tool. The results showed that a hand pressed mixture of jatropha seed husks, pyrethrin and cow dung (binder) in the ratio of 3 g: 0.5 ml: 2 g respectively can cause a 100 % mosquito knockdown within 10 min. and mortality of 97.50 % within 24 hr when burnt indoors. The percentage mosquito knockdown and percentage mortality rate were found to vary significantly with the amount of pyrethrin used. It is expected that the findings of this study will generate new knowledge on briquette development and also contribute to waste management. The research findings will also contribute towards reducing the death rate resulting from malaria [4]. Fuel briquettes are essentially a thick, compressed disk of organic waste materials used for cooking and/or heating. They are often used as a development intervention as a replacement for firewood, charcoal, or other solid fuels. In the proper context fuel briquettes can: save time, save money, decrease local deforestation rates, and provide and income generating opportunity[7].

2.1 Materials and Methods

The raw materials used included 25% Pyrethrin obtained from Kenya Pyrethrum Board, Nakuru, Kenya, jatropha curcas seed husks obtained from Jomo Kenyatta University of Agriculture and technology (JKUAT), Kenya, and fresh cow dung from Kiangari Secondary School, Muranga, Kenya.

2.2 Mosquito species used

Female Aedes aegypti mosquitoes were used in this research.They were obtained from Kenya Pyrethrum Board Entomology laboratory, Nakuru, Kenya. Their methods of control are similar to those of the Anopheles mosquitoes.

Table 1. Ratio of jatropha to cow dung to pyrethrin in the briquette samples.

Sample	Jatropha husks (g)	Cow dung (g)	Pyrethrin oil (ml)
A(control)	3	2	0
B	3	2	0.1
C	3	2	0.2
D	3	2	0.3
E	3	2	0.4
F	3	2	0.5

III. METHOD OF PRODUCTION OF JATROPHA FUEL BRIQUETTES

In Guatemala, an organization named Techno Serve has identified Jatropha seed cake as an interesting source of raw material for fuel briquettes. In the field investigation with TechnoServe, the objective is to determine the feasibility of a briquette from Jatropha seed cake in combination with rurally available organic waste materials in the Chiquimula Department. A materials assessment of three various communities in the department has shown that corn husks, corn stalks, cow dung, Jatropha fruit shells, and coffee husks are ideal waste materials because of availability. Other waste streams, such as banana peels and orange rinds were identified as potential materials, but were not investigated in this study.

A comprehensive set of recipes, all including Jatropha seed cake, were made with the identified materials from the material assessment. Each composition was then compressed into briquettes using a manual screw press. Cow dung, corn husks, and sawdust were the only materials tested that could physically form a briquette with the seed cake. Although several briquettes could be physically held together, a prerequisite to a viable fuel briquette is the ability of the briquette to combust. During the combustion testing neither the briquette using cow dung nor corn husk were able to sustain a quality burn in a local stove. The sawdust briquette burned better than the others, but still could not maintain a flame. It has been inferred that in order to produce a briquette containing Jatropha seed cake that will combust it either needs a custom stove and/or to be combined with a highly combustible material. The developed briquettes are tested for their effectiveness in knocking down and killing mosquitoes at the Kenya Pyrethrum Board laboratory. This likely involves controlled experiments to assess the impact of burning the briquettes on mosquito populations.

3.1 Jatropha Fruit Shells

The shell from the pod which contains the Jatropha seeds provides a logical pairing with the Jatropha seed cake because they come from the same plant and same farmers. As of now, the seed cake and shells are in different locations, but that can be changed by bringing the full fruits to the oil extraction site. The shells have high fiber content and can theoretically be used as a binder, however our material assessment did not allow enough time to ecompose the material enough to produce a viable briquette (see Permutations of Briquette Compositions section). This material should be investigated further to determine if it is feasible as a binder.

Fig. 1 Jatropha seed shell

IV. TESTING AND RESULTS

4.1 Squeeze Test: Place a small handful of the wet mixture in the palm of your hand and squeeze, as shown in Figure 2 If any of the material oozes through your fingers then the material is too decomposed.

Fig. 2 Squeeze Test

4.2 Expansion Test: After the Squeeze Test, open your hand, as shown in Figure 3. If the material expands more than roughly 10% of its size then the material is not decomposed enough.

Fig. 3 Expansion Test

4.3 Shake Test: After the expansion test, hold the top half of the material, as shown in Figure 4 Lightly shake the material vertically several times. If the material falls apart than there are not enough fibers holding the mixture together. Either more binder or a new binding material must be used.

Fig. 4 Shake Test

4.4 Jatropha Seed cake: Jatropha seed cake as shown in figure 5 is not currently widely available, however it will be when TechnoServe‟s Jatropha Biofuel program is functioning at full capacity. The seed cake will be available at the site of oil extraction. The location of these extraction sites will greatly impact the model for how the fuel briquettes will be distributed and sold. If the production of Jatropha seed cake is in a centralized location, such as INTECAP in Chiquimula, will have a cost associated with the transport of the material back to the communities who wish to produce briquettes. Depending on where there is a strong demand for briquettes it may be more feasible to manufacture briquettes where the seed cake is produced, or to transport the material to another location.

Fig. 5 Jatropha Seed cake

V. CONCLUSIONS

The research findings suggest that a combination of jatropha seed husks and pyrethrin, hand-pressed with cow dung as a binder in specific proportions, can yield fuel briquettes capable of effectively combating mosquitoes. The ratio used for the mixture was 3g of jatropha seed husks, 0.5ml of pyrethrin, and 2g of cow dung. The study demonstrated that these briquettes, when burned indoors, achieved significant mosquito knockdown rates. Specifically, they achieved 100% mosquito knockdown within 10 minutes of burning, with a subsequent kill rate of 97.6% within 24 hours. These results are notably superior to the standards outlined in the Kenya Standard Specification for mosquito coils from 2000, which requires a knockdown of 50% within 20 minutes and a kill rate of 90% within 24 hours for mosquito coils. This research indicates that these briquettes have potential as an effective and efficient means of mosquito control, offering a natural and environmentally friendly alternative to traditional mosquito coils.

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