European Journal of Social Sciences Studies
ISSN: 2501-8590
ISSN-L: 2501-8590
Available on-line at: www.oapub.org/soc

doi: 10.5281/zenodo.3459873 Volume 4 | Issue 4 | 2019

AZIDIRACHTA INDICA AND ITS POTENTIAL FOR THE PRESERVATION OF *BAMBUSA VULGARIS* IN GHANA

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Abstract:
Bamboo is a renewable natural resource which is woody, precious, physically powerful and exceptionally fast-growing grass which plays important role in the world's economy; however in Ghana, most bamboo industries use chemical preservatives which are expensive and poisonous product for the preservation of bamboo which also have rippling effects on the users of bamboo products and the environment as whole. The study used the descriptive and experimental research methodologies with interview and observations as data collection instruments to gather data from respondents. Stratified Random sampling technique was employed to sub-divide the population into smaller homogeneous group so as to get more exact representation. The study discovered azadirachtin in the neem is the plants main agent for battling insects. It appears to cause about 90% effectiveness in dealing with most pests. The azidarachtin does not kill insect but it repels and disrupts their growth and reproduction. Moreover, it was found that neem leave extracts, as a preservative, is more suitable for the preservation of domestic products such as chopsticks, ladles, chopping boards and fruit trays. It is recommended that, a more environmentally friendly chemicals such as the azadirachtin must be used in the preservation of bamboo.

Keywords: gummy substance, infest, culm, termite, microorganism, craftsman, filter, hazard

1. Introduction

Undoubtedly, bamboo is a material with numerous uses and of much economic importance to the economies within the areas they are located. Although this non-timber forest product is a good material, its traditional use has been restricted to the

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construction of temporary structures and is used where cheap and inferior materials are needed. The bamboo plant is a renewable natural resource and very essential in the development of the world's economy. Wood resources is depleting considerably in the sub-Saharan Africa, and mostly in the Ghanaian forests (reference backed by figures). Accordingly, much attention has been drawn to bamboo as result of its beneficial characteristics. Bamboo has gain economic prominence because it is renewable, environmentally friendly, widely available, grows and adapts to most climatic situation and possesses features that are of better-quality if compared to other plants species. Despite its prominence, bamboo is often and mostly used for fencing and in places where low graded material is required in construction firms. Despite its prominence and versatility, bamboo plant has a shorter life span due to the attack by pests and wood degrading organisms.

Bambusa vulgaris specie of bamboo is common in Ghana, this species has within it high amount starch, sugar, wax, gammy substance and lignin materials which easily attracts pests, fungi, borers and other biodegrading organisms to attack its *culm* rendering it less durable and unattractive for production of any artifacts by the local craftsmen (Baah, 2001). Mostly, the craftsmen in the bamboo industry work with inorganic, imported and expensive preservatives which poses more treat to the user and the environment, Odei (2004) asserted that such chemicals are toxic and causes many problems to the craftsman and users of the bamboo product preserved with such chemicals therefore suggested that research into other alternative organic preservative which will be easily accessible and available, human and environmentally friendly. This study is purposely conducted to experiment plant extracts that has the potentials of preserving *Bambusa vulgaris*, and the potentials of extracts from neem leaves *(Azidirachta indica)* for the preservation of *sympodial* bamboos in Ghana. (*Bambusa vulgaris*). Accordingly, the researcher sort to identify and study the traditional methods bamboo preservation, identify the active ingredient in neem plant as potential material for bamboo preservation, and to apply and test the efficacy of neem leave extract as preservative on *Bambusa valgaris*.

2. Literature Review

Bamboo preservation has been studied by some researchers and different views and methods have been documented in the literature reviewed in this chapter. Bamboo is an outstanding material for innumerable applications ranging from handicrafts and utility items to industrial products and structural components of bridges and buildings. With such extensive applicability, it offers incredible source of revenue potential for rural and urban communities and business opportunities for industry. Although the advantages of bamboo are well known, its wider exploitation is disadvantaged by its receptiveness to natural degradation. Like weakening of wood, deterioration of bamboo can be disallowed from beginning to end through appropriate and safe treatments during storage, processing and use. Although such practices have been in use for some time,

relevant information on the various preservation procedures is not adequately available.

From compiled notes on bamboo, Baah (2001 p1) said that "*there is hardly any rival to bamboo in the plant kingdom*" According to him, from ancient times, bamboo has been linked to human livelihood, fulfilling needs for furniture, entertainment, housing and food in some cultures. Addai (2003 p.5) confirms the fact that "*Bamboo is a grown grass belonging to the family called Grannae and occurs in two main ecological forms - monopodial and sympodial bamboo*." He further stated that they grow in the temperate climate and in the subtropics and tropics.

From the report published by the International Network for Bamboo and Rattan (INBAR) (1998), it was stated that compared with other woody plants, Bamboo is a fast growing plant. It was further stated that it takes between forty to sixty days for Bamboo to reach a maximum height. Examples of some giant Bamboo was stated to have reached a height of thirty to thirty six meters and could survive all kinds of conditions.

2.1 Ghanaian Bamboo Species

The local species of bamboo in Ghana as indicated by Baah (2001) numbered to seven. They include; *Bambusa pervariabilis, Bambusa vulgaris, Dendrocalamus strictus, Bambusa arundinacea, Bambusa multiplex, Bambusa bambos* and *Bambusa var vitata*. In the midst of these, *Bambusa vulgaris* is native to Ghanaian environment.

Figure 1: *Bambusa Vulgaris var vitatta*



Figure 2: *Bambusa Vulgaris*



Bambusa vulgaris is extensive in Ghana and can be easily propagated or cultivated. A study conducted on this particular bamboo shows a very low opposition to biological corrupting agents or pests and fungi. Although like all other bamboo varieties *Bambusa vulgaris* has within its structure starch, wax, gum and lignin which gives strength to the material, the presence of sugar makes the material defenceless, since the sugar content is on the elevated side making the bamboo sweet and attractive to pest. This particular bamboo is yellow in colour with longitudinal green stripes running from node to node. It is very light in mass. It is found around the compounds

of most organization as part of ornamental plants grown to impr0ve the aesthetic appearance of their surroundings.

2.2 Traditional Uses in Ghana

According to Baah (2001), because of bamboo similarly short life range, bamboo is, customarily, and normally utilized in production of products that are less durable.

Bamboo culms, split or entire culm, make it easier to build fence wall protection, kitchens and bathrooms in rural settlement and lower income communities. Bamboo culms that have been split into pieces that are used to roof house and could last for a span of more than two years. Parts and the entire bamboo culms are used to make benches public places and mostly under shades for relaxation. Painstaking work, for example, spatulas, wooden spoons and other kitchen wares are produced using the split bamboo culms. Most of these products do not last, because the preservative treatment given is not adequate or not preserved at all.

2.3 Non-Traditional Uses

Steiner (2016) in a personal interview opined that, in recent years in the building and construction industry, wawa poles that were once used as props for scaffolding and for casting concrete flooring have become scarce and expensive and have been replaced with bamboo culms. In the craft industry whole and split culms are carved into various decorative items. In the furniture industry bamboo culms are complemented with timber wood for the manufacture of furniture. In more recent years the technique of splitting the culms of *Bambusa vulgaris* into slivers for various uses is becoming a novel practice.

2.4 Traditional Methods of Preservation of Bamboo

Traditional methods are ways that indigenous people have developed over the years in giving preservative treatment to their local bamboo for use in housing, fencing and other forms of construction. Addai (2003) said at Apeadu Kokobin in the Asukwa East district of Ashanti, bamboo for housing is cut fresh and buried in swamps of water for at least three days, they are then carried home and kept in the kitchen as over ceiling for smoking and drying. This makes the bamboo unattractive to pest.

3. Methodology

The descriptive and experimental methods of the qualitative research paradigm were adopted to bring together data for the study. The descriptive research method was used to describe the entire research and the experimental research method was used for formulating the processes of extracting the preservatives from plants for the preservative treatment of *sympodial* bamboos. The researchers visited the following Bamboo Preservation Centers; Assin Fosu Bamboo factory where he was taken through the primary processing stages, and the preservation of the bamboo. The Stratified

Random sampling technique was employed to sub divides the population into smaller homogeneous group so as to get more exact representation. This was essential in reducing and allowing the generalization of the findings. A sample of 29 (70%) of the whole population was adopted. The minimum of 70% was picked on the grounds that the study considered 70% of the sample as an adequate figure since the aggregate number of respondents in this research was around 41. The population was sub-divided into three categories comprising:

a) Senior officers of institutions and teachers of bamboo art
b) Technicians of Bamboo industries and research institutions.
c) Artisans working in bamboo.

1. Category A – 5
2. Category B – 26
3. Category C – 10

Total 41

With this information, the study considered a sample of 29 (70%) to be a representation of the total population which became accessible population. The base of 70% was picked in light of the fact that the study considered 70% of the sample as acceptable figure since the aggregate number of respondents in this project was around 41. The total sample was also shared among the three layers (categories A, B, and C) of the total population. Each stratum or layer is homogenous. The number of subjects required in the sample was later computed according to calculated percentages (Table 2). The survey instruments were interview and observations which were used to gather data from respondents, with reference to the preservation methods adopted for preserving bamboo and the operation of the components of plant for giving the preservative treatment to bamboo.

The descriptive and experimental methods of the qualitative research standard were employed to bring together data for the study. The descriptive research method was used to describe the entire research and the experimental research method was used for formulating the processes of extracting the preservatives from plants for the preservative treatment of sympodial bamboos. The Stratified Random sampling technique helped the researcher to sub divides the population into smaller homogeneous group so as to get more exact representation. It reduced biases and allowed the researcher to generalize his finding to the entire population. This method was in this manner used to choose the sample of 29 (70%) of the whole population. The minimum of 70% was picked on the grounds that the researcher considered 70% of the sample as an adequate figure since the aggregate number of respondents in this project or research was around 41.

3.1 Population

The population was divided into three categories comprising:

1) Senior officers of institutions and teachers of bamboo art;
2) Technicians of Bamboo industries and research institutions;

3) Artisans working in bamboo.

Table 1: Categories of Personnel

Category A (Layer 1): Senior officers/ Teachers of bamboo art	**5**
Category B (Layer 2): Technicians of Bamboo industries and research institutions	**26**
Category C (Layer 3): Artisans working in bamboo	**10**

Source: Field study, 2019.

Table 2: Sampling of layers

Status	Number in Sample	%
Category A (Layer 1)	5	**12.2**
Category B (Layer 2)	26	**63.4**
Category C (Layer 3)	10	**24.4**
Total	**41**	**100.0**

Source: Field study, 2019.

A total potential population for this research project was (41 respondents) forty-One made up of the senior officers in institutions, field technicians working in institutions and establishments and artisans working in bamboo.

3.2 Survey Instruments

The survey instruments were interview and observations which were used to gather data from respondents, with reference to the preservation methods adopted for preserving bamboo and the operation of the components of plant for giving the preservative treatment to bamboo.

3.4 Data Collection

The study used the descriptive and experimental research methodologies for the project or research. The primary data were solicited from the senior officers of institutions and establishments. These comprise managers of bamboo factories their deputies, heads of research institutions and lecturer and teachers of bamboo art and technology from K N U S T, Kumasi. The Secondary data were composed mostly from documentary sources (books, publications, periodicals, charts, brochures and thesis). In all the various areas visited, efforts were made to collect the necessary data. Data collected from technicians and artisans were all assembled, analyzed and used where necessary for the project.

3.5 General Procedure for the Project

Preservation of bamboo culm is made both in a boiler or place for stacking, or in a diffusing trough. This particular process embraces diffusion, painting and boiling in extracts produced out of neem leaves. This process is very essential in giving preservative treatment to bamboo and it is designed to solve problems of ecologically unfriendliness. Several little branches of the neem were cut and put in a sack for transporting from Emina hospital junction in Kumasi to the project site at KNUST

where they were washed thoroughly with water. Woody parts of the material harvested were taken out of the material stuck to ensure that the leaves are the main material under consideration.

Figure 3: Neem leaves after washing



12 kilogram mass was pounded in a metal mortar with a metal pestle. The pounding was done until the leaves were torn into tiny leafy sheets. The pounded leaves were soaked for 24 hours with 12 liters of water. The soaked pounded leaves was stirred and sieved through a 60 mesh sieve into a plastic container with the capacity to hold 15 liters of liquid. Samples of *Bambusa vulgaris* were submerged in the neem extract for 21-100 days. After these days the bamboos were removed from the neem extracts and dried in the sun.

Figure 4: *Bambusa vulgaris* in Neem Leaves Extract



The researchers are of the view that, if water could facilitate leaching out of soluble sugars through osmosis, then liquid neem extract will do both leaching out of soluble sugars and then preserve the bamboo against pest infestations. It was against this background that the researcher considered 30 days submersion, 60 days

submersion and the 100 days submersion to ascertain the effectiveness of the neem extract as suitable for the preservative treatment of bamboo.

Figure 5: Bamboo Culms Soaked in Neem Leave Extract



Samples of *Bambusa vulgaris* were submerged in the neem extract with salt, and it was brought to boil for 2 hours on a high pressure gas burner. After boiling, the bamboos were taken out of the neem extracts and dried in the sun.

Figure 6: Boiling of the Bamboos on a High Pressure Gas Stove



A 15 cm brush was used to paint the bamboo vases with the neem extract. Preservation of bamboo by painting with neem extracts was another method which was considered to test the efficacy of neem as a material for preservation.

Figure 7: Painting the bamboos with neem leave extract



3.6 Test Conducted on the Procedures

After the activities of preservation with neem extracts had been carried out, tests were conducted on the samples of *Bambusa vulgaris* that were subjected for preservation with the neem extract to ascertain the efficacy of the neem for the preservative treatment of bamboo. All the work pieces and samples of bamboos were subjected to test. These were exposed to pest for infestation to test for the efficacy of the neem extract for the preservation of bamboo.

Figure 8: Termite test for split bamboo culms



Samples of the *Bambusa vulgaris* were exposed to termites, to test the efficacy of the neem extract which produced by soaking neem leaves over three weeks. The exposure of the bamboos was for three weeks. This was met by intermittent watering by the rain which helped to create an abode for the termites around the bamboo. In contrast to the assertion that bamboo is highly lignified and very difficult for liquids to penetrate, most writers on the subject recommended submersion and boiling in preservatives. Again, some of the treated bamboos were also placed together with already infested bamboos in a borer prone area to test the efficacy of the preservative on

the *Bambusa vulgaris* for three weeks. According to Dr. Frimpong an entomologist from CSIR, it is believed that since the borers have gather together in that area attacking the bamboo will be easy and fast since they would be attracted to new bamboos to feed on.

Figure 9: Sample of Treated *Bambusa vulgaris* Placed in a Borer Prone Area



4. Results and Discussion of Findings

The principle by which liquid preservatives enter into bamboo for preservation is by diffusion irrespective of the methods adopted, and again preservation could be done either by boiling, painting, diffusion by submersion, injection of preservative or using a kind of pest killer or repellant. One of the traditional methods used involves extraction of gummy or sticky substances which decreases the starch content in the bamboo while the removal of the starch decreases makes it unattractive for fungi and insects attack. It could be concluded that traditional bamboo preservative methods is part of the overall achievements of a society and this forms an integral part of our culture. azadirachtin was discovered to be the active ingredient in the neem plant. It is one of the first active ingredient isolated from neem and has proved to be the plants main agent for battling insects. It appears to cause about 90% effectiveness in dealing with most pests. The azidarachtin in the neem plant does not kill insect but it repels and disrupts their growth and reproduction. Research for the past 20 years has shown that it is one of the most potent organic growth regulator and feeding deterrents ever gotten.

Samples from the experiments conducted with the neem extracts treated bamboos, and split bamboo preserved with neem extracts were exposed to termites and borers for almost four weeks. The sample pieces that had been split and preserved were also taken out and cleared of the mud for close observation. It was evidently clear that sample of bamboo pieces were not affected. The other sample pieces were also removed, cleared of the moulds, examined for borer's infestation by the researcher, there had not been any evidence of any part of the samples being affected, infested or eaten up by pest or the borers.

Figure 10, 11 & 12: Samples of bamboo preserved with neem leave extracts



5. Conclusion and Recommendations

Several methods of protecting bamboo was done in fast, convenient and affordable means which included soaking in the mud or water, smocking, good harvesting times and others, all with the aim of making it durable, last longer and also protecting the environment. The experiment conducted indicates the possibilities of preserving bamboo using neem leave extracts, which is readily available in the locality, provide job opportunities for most of the unemployed youth in the country and will also goes a long way to protect the environment from hazardous chemicals that pollute the natural environment. Considering the research conducted and the active ingredients in the preservative, it was discovered that neem leave extracts, as a preservative, is more suitable for the preservation of domestic products example chopsticks, ladles, chopping boards, fruit trays and anything that will serve as a carrier or container for edibles and other small items such vases, wall hangings and other decorative pieces. The cost of preserving bamboo using neem leave is as cheap and easy to work with as most of the traditional methods been used by our local craftsmen.

5.1 Suggestions for future research

The study recommends that; there should be more research into other environmental friendly (organic) means of preserving bamboo apart from using the neem leaf, which will go a long way to help solve many environmental problems attributed to the use of poisonous substances for preservation. There is the need to research into adaptation of other bamboo species of the fast growing and pest resistant group and biological preservative into the country to help make the nations dream of turning away from the usage of poisonous chemicals to save our forest and the environment a reality.

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