# Effects of Age and Bamboo Portion on the Ash and Silica Content of Buluh Semantan (*Gigantochloa Scortechinii*)

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ABSTRACT

*Sixty bamboo culms were harvested from six bamboo clumps and were cut into three portions namely; basal, middle and top portions. Bamboo samples were then granulated into wood meal and those retained on the 60 BS mesh sieve were used in the study to determine the ash and silica content. Age was found to significantly affect the ash and silica content. However, bamboo portion showed no significant effect.*

**Keywords**: *ash, age, bamboo portion, Gigantochloa scortechinii, silica*

## Introduction

Bamboo is a giant grass which is a member of the *Gramineae* and forms the tribe *Bambuseae* of its subfamily *Bambusoideae*. There are about 60 genera of bamboo in the world and the number of species is estimated to be about 1200. Bamboo is a valuable gift of nature to mankind and has been greatly used in Tropical Asia, particularly, in rural areas owing to its availability, renewability, short maturity cycle, fast growth, high productivity of shoots and culms and its multiple uses.

Mankind has been exploiting bamboo for various purposes in many parts of the world. It is also considered as the oldest building material in the rural areas due to its easy availability, low cost and strength. In Malaysia, it is viewed as a multipurpose plant with a wide range of uses, such as in the construction industry, in the production of pulp and paper, barbecue sticks, chopsticks, joss sticks and as a source of food (Abdul Latif and Mohd Tarmizi, 1992).

Ash is an inorganic compound that remains after high-temperature combustion in the presence of abundant oxygen. It is traceable to the occurrence of incombustible compounds containing elements like calcium, potassium, magnesium, manganese and silicon (Haygreen and Bowyer, 1989). The ash content of bamboo is higher in the inner than the outer part while the silica content varies from 0.5% to 4.0%, increasing from the basal to the upper portions. Silica is deposited in the epidermis – the skin zone – whereas the nodes contain little silica and the tissues of the internodes almost none. Silica content affects the pulping properties of bamboo.

Silica, besides giving rise to the blunting of saw tooth, may also cause problems during chemical recovery of black liquor in the manufacture of chemical pulps. The difficulty with silica is also encountered in the filterability of dissolving pulp and its removal, together with other mineral impurities, is an important procedure in rayon manufacture. Knowledge of the ash and silica content would enable a mill to take measures to avoid such problems. This paper discusses the effects of bamboo age and height portion on the silica content in *Gigantochloa scortechinii.*

## Materials and Methods

### Materials Preparation

Bamboo samples, Buluh Semantan (*Gigantochloa scortechinii*) of one to three-year old of age, were obtained from the bamboo plantation in Forest Research Institute of Malaysia (FRIM) Kepong. Ten bamboo culms were harvested from each of six bamboo clumps and were cut into three portions namely; basal, middle and top portions. From each bamboo portion, a one-inch ring sample was cut from the base of each bamboo culm to represent each bamboo portion. The samples were cut into splint-sized sticks and reduced to wood meal through a Wiley mill. Bamboo samples that passed through a BS 40-mesh sieve and retained on a 60 BS-sieve were used in the study.

### Ash Determination (TAPPI T15- Ash in Wood)

Six crucibles were dried in a muffle furnace for one day at 700°C. Then, it was cooled and weighed. For each determination, seven gram of bamboo sawdust was weighed and placed in the crucible and then placed on the hot plate. A few drops of concentrated sulphuric acid were added to the bamboo sample. When the bamboo meal was completely digested,

it was ashed in the muffle furnace at 700°C for 24 hours. The difference in weight gives the ash content of the bamboo portion.

### Silica Determination (TAPPI T245- Silicates and Silica using Wet Ash Method)

The ash produced in the above experiment was used. The ash was further heated on the hot plate. One ml of concentrated sulphuric acid and one ml of hydrofluoric acid were added. The crucibles were then heated in a muffle furnace at 1000°C for 24 hours. Then, the crucibles were cooled and weighed. The weight difference gives the silica content of the bamboo portion.

## Results and Discussion

### Ash and Silica Content

The ash and silica content of *Gigantochloa scortechinii* according to age and bamboo portion is shown in Table 1. The highest ash and silica content for the one-year-old bamboo was found at the basal portion with values of 1.24% and 1.03%, respectively. For the two year-old bamboo, the highest ash content was located at the top portion (2.47%) and the silica content (1.98%) was found at the basal portion. The highest ash (1.93%) and silica content (1.55%) was found at the basal portion in the three year-old bamboo.

Table 1: Ash and Silica Content of *Gigantochloa scortechinii* According to Age and Bamboo Portion

| Age (Years) | Bamboo Portion | Ash (%) | Silica (%) |
|---|---|---|---|
| 1 | Basal | 1.24 | 1.03 |
| | Middle | 1.24 | 0.96 |
| | Top | 1.11 | 0.69 |
| 2 | Basal | 2.25 | 1.98 |
| | Middle | 1.89 | 1.70 |
| | Top | 2.47 | 1.83 |
| 3 | Basal | 1.93 | 1.55 |
| | Middle | 1.42 | 0.94 |
| | Top | 1.54 | 109 |

*Note*: Values are averages of 6 determinations

In this study, the ash content varies from 1.24% to 2.47% and is higher compared to the findings reported by Jamaludin et al. (1992) but is still in the acceptable range as reported by Abd Razak (1995). *G. scortechinii* contains lower amount of ash when compared to Phlillippine bamboo (Semana et al., 1967) and Indian bamboo (Guha, 1992). Abd Latif and Mohd Tarmizi (1992) reported that the relatively low ash content in *G. scortechinii* explains its various uses particularly in the production of incense sticks in Peninsular Malaysia. The amount of silica content obtained in this study (0.69 – 1.98%) is still in acceptable range as reported by Abd. Razak (1995).

## Statistical Significance

Table 2 shows the analysis of variance (ANOVA) on the ash and silica content. Age was observed to have significant effect on the ash and silica content. Bamboo portion, however, was found to have no significant effect on the ash and silica content. The age and bamboo portion interaction also showed insignificant effect on the studied properties.

Table 2: Summaries of the ANOVA of the Effects of Bamboo Age and Portion on Ash and Silica Content

| Source of variance | df | Ash | Silica |
|---|---|---|---|
| Age (A) | 2 | 0.13* | 0.20* |
| Bamboo portion (P) | 2 | 1.53ns | 1.39ns |
| A X P | 4 | 0.10ns | 0.05ns |

*Note*: df- degrees of freedom, *- f-value significant at $p < 0.05$ probability level

## Effect of Age on Ash and Silica Content

The effects of age on ash and silica content are given in Table 3. From the table, it can be seen that the ash content increases significantly from one year-old to two year-old bamboo and decreases significantly in three year-old bamboo. The trend was also reported by Abd. Latif et al. (1994). Table 5 (correlation analysis) reveals that the increase in ash and silica content with age is not significant indicating that there is no significant correlation between the properties studied with the age of bamboo.

Table 3: Effect of Age on Ash and Silica Content

| Age (yr) | Ash (%) | Silica (%) |
|---|---|---|
| 1 | 1.20b | 0.89b |
| 2 | 2.20a | 1.83a |
| 3 | 1.63b | 1.19ab |

*Note*: Means having the same letter down the column are not significantly different at $p < 0.05$ probability level.

## Effect of Bamboo Portion on Ash and Silica Content

Table 4 shows the effects of bamboo portion on the ash and silica content *of G. scortechinii*. The ash and silica content decreases insignificantly with increasing bamboo portion. Table 5 further shows no significant correlation existed between the ash content ($r = -0.09$) and silica content ($r = -0.30$) with bamboo portion.

Table 4: Effect of Bamboo Portion on Ash and Silica Content

| Bamboo Portion | Ash | Silica |
|---|---|---|
| Basal | 1.81a | 1.52a |
| Middle | 1.51a | 1.20a |
| Top | 1.71a | 1.20a |

*Note*: Means having the same alphabet down the column are not significantly different at $p < 0.05$ probability level

Table 5: Correlation Coefficients of Age and Bamboo Portion with the Ash and Silica Content

| Variable | Ash | Silica |
|---|---|---|
| Age | 0.39ns | 0.28ns |
| Bamboo Portion | -0.09ns | -0.30ns |

*Note*: ns- not significant at $p < 0.05$ probability level

## Conclusion

The ash and silica content of *G. scortechinii* increased from one to two year-olds but it decreased in three year-olds. Bamboo portion, however, showed no significant effect on the properties studied. Even though one year-old bamboo had the lowest ash and silica content, its utilisation is

not recommended since its harvesting will lead to the species' extinction. Irrespective of the bamboo portion, any portion can be utilised in the production of bamboo products.

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