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# THE EFFECT OF BAGASSE FIBER ADDITION IN FLEXURAL STRENGTH OF BULK FILL COMPOSITE RESIN

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***ABSTRACT***

***Background:*** *Bulk fill composite resin is a packable composite resin that has been modified to solve the deficiency of conventional composite resin. The addition of fiber can increase the mechanical properties, one of them is flexural strength. Fiber is consisted of two types which are synthetic fiber and natural fiber. In Indonesia, there are many natural fibers, one of them is from the plant of sugarcane. The baggase is the residual from sugarcane plant that had been processed for the making of sugar.* ***Purpose:*** *To acknowledge if the addition of baggase fiber affect the flexural strength of bulk fill composite resin.* ***Methode:*** *This study wastrue experimental studywith post-test only control group design and used simple random sampling that consisted of 3 groups, which are group with addition of baggase fiber, group without addition of baggase fiber as the negative control and group with addition of synthetic fiber as the positive control. Flexural strength tested with Universal Testing Machine.* ***Result****: The average value of flexural strength on group with addition of baggase fiber, group without addition of baggase fiber and group with addition of synthetic fiber were 123,549 MPa; 118,125 MPa and 144,442 Mpa respectively. One Way Anova and Post Hoc Bonferroni test showed that there is significant difference between all treatment groups.* ***Conclusion****: Based on this study, it can be concluded that addition of baggase fiber can increase the flexural strength but cannot replace the synthetic fiber.*

*Keyword: Bulk-fill composite resin, flexural strength, addition fiber*
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## INTRODUCTION

The bulk fill composite resin is packable composite resin that has been modified to overcome the deficiencies in conventional composite resins. This type of composite resin is often used for restoration of posterior teeth.[1] Considerations for application of composite resin on the tooth are its mechanical properties such as compressive strength and flexural strength of the restorative material, especially for the posterior tooth with a large mastication pressure.[2]

The flexural strength is the ability of the restorative material to resist the flexural force in the anterior and posterior areas during mastication. The flexural force is a mixture of is the tensile and compression forces.[3]The mechanical properties and the matrix's properties are influenced by the density of the filler. Rising in filler levels can reduce the shrinkage of the polymerization, linear expansion coefficient and water absorption and increase compressive and tensile strength, elastic modulus and wear resistance. The addition of fiber will increase the density of the filler which will also affect the increase of mechanical properties of composite resin.[2]

There are two types of fibers, synthetic fibers made in the factory and natural fibers.[4] This synthetic fiber is most used because it is ready to use and more practical, only this fiber has disadvantages such asexpensive price and require chemical process in the making, so it is necessary to find alternative materials in the form of natural fibers which are cheap, easy to obtain, easy to manufacture, haslow density, environmentally friendly, and can be decomposed biologically.[5] Indonesia has many natural fibers, one of which comes from sugar cane .[6] The use of bagasse fiber as a substitute for synthetic fibers in the field of dentistry has not been done. The bagasse is the leftover of the processed sugarcane for making sugar. Amounts of bagasse fibers are abundant, but the usage of bagasse is largely only as fuel.[7]The bagasse has properties that are not too hard but also less flexible because the upper layer has hard feature while the structure is composed of thick corks. This cork also makes the bagasse can return to its original shape when pressed and able to absorb moisture. The baggage has color of white which makes it more aesthetic .[8]

Based on the description above, the researcher is interested to do research about the effect of adding bagasse fiber to the flexural strength of bulk fill composite resin. The purpose of this research is to determine the effect of adding bagasse fiber to the flexural strength of bulk fill composite resin.

## MATERIAL AND METHOD

This research used a true experimental study with post-test only control group design, to analyze the flexural strength of bulk fill composite resin with addition of bagasse fiber. The sample of this research used bulk fill composite resin with length 25 mm, width 2 mm and height 2 mm based on ISO 4049. The sample of each treatment group was 7 samples. The total sample for this research is 21 samples with simple random sampling techniqueconsisting of 3 treatment groups. Group I: Bulk fill Composite resin with addition of bagasse fiber; Group II: Bulk fill Composite resin with addition of synthetic fiber; group III: Bulk fill Composite resin without fiber addition.

The bagasse fiber which wasthe leftover of the milled sugar cane was soaked in 1 day. The bagasse fiber then combed using a wire brush to remove the cork attached to the fiber.After that the fiber wasdried for 1 day. The dried bagasse fiber was combed again to remove the cork that was attached to the fiber. The fibers in bagasse were taken manually one by one by hand to get the yarns of bagasse fiber. Preparation of the samples with the addition of fibers of bagasse and synthetic fibers, was by placing thesculptable composite resin on a 25x2x2 mm mold base with a thickness of about 0.5 mm using a plastic filling instrument. The bagasse fibers and synthetic fiber are arranged on glass plate, then the fiber was smeared with primer using microbrush and given flowable composite. Fiber were held with tweezers to avoid contamination. The fibers were placed on composite resin layer that was already placed before. The polymerization used light curing with LED units for 20 seconds with lighting divided into 3 parts along the specimen. Then, the fiber was coated with a sculptable composite resin till the mold was filled. The surface of the mold was covered with a glass slide and pressed with light pressure and each side were clamped to allow the excess of resin to come out. The strip matrix was placed between glass slides and mold. Next, the polymerization with light curing by LED units was donein the same way as in the first layer.

The preparation for negative control sample was by inserting the composite resin into a mold with a thickness of 2 mm, then light cured by LED unit for 20 seconds with lighting divided into 3 parts along the specimen. The composite resin was removed from the mold and the sample was immersed in a saline solution then put into the incubator for 24 hours at 37 ° C before testing. One hour after removal from the incubator, the specimen was tested at 3-point bending using Universal Testing Machine.The specimen was placed on the test device with a 20 mm bending span, loading piston was perpendicular to the width of the fiber. The specimens were given a maximum load of 50 kgf with a crosshead speed of 0.5 mm / min.

## RESULT

The average value of flexural strength of bulk fill resin composite with the addition of bagasse fiber, synthetic fiber and without addition of fiber can be seen in table 1..

Table. Mean Value of Flexural Strength of Bulk fill Composite Resin with addition of bagasse fiber, Synthetic Fiber and without fiber.

| Group | Mean (±) Standar Deviation |
|---|---|
| Without Fiber | 118,125 ± 1,0126 |
| Bagasse Fiber | 123,549 ± 0,9704 |
| Synthetic Fiber | 144,4419 ± 1,1298 |

Based on the result of normality test, the flexural strength of bulk fill resin composite showed that p = 0,949 for group without fiber, p = 0,686 for bagasse fiber group and p value = 0,976 for synthetic fiber group where (p> 0,05) which mean the data is normally distributed. The homogeneity test with *Levene's Test* showed that the flexural strength data had significance of 0.924 (p> 0.05) which means that the data is homogenous.

The result of normality and homogeneity test showed that the data from flexural strength of bulk fill resin was normally distributed and had homogeneous variant, so it couldbe continued by statistical test using *One Way Anova* parametric test. The results of *One Way Anova* parametric test showed p = 0,000 (<0,05), which means there were at least 2 treatment groups that have significant difference on flexural strength. The next test was the *Bonferroni Post Hoc* test to find out which of the groups has significant difference on flexural strength. The result of *Bonferroni Post Hoc* test can be seen in table 2.

Table 2. Result of *BonferroniPost Hoc test*

| Group | Sig (p) |
|---|---|
| Without Fiber vs Bagasse Fiber | 0,000* |
| Without Fiber vs Synthetic Fiber | 0,000* |
| Bagasse Fiber vs Synthetic Fiber | 0,000* |

*= There is a significant difference (p<0,05)

Based on the results of the *Bonferroni Post Hoc* test on the table it was found that the result p <0.05 which means there was a significant difference between all treatment groups.

## DISCUSSION

Based on the results of this study, it was found that there were significant differences in flexural strength between composite resins with added fiber compared with composite resins without fiber where flexural strength with fiber addition was higher than without fiber addition. The results also showed a significant difference in flexural strength between the groups with the addition of bagasse fiber and without addition of fibers where flexural strength with the addition of bagasse fibers is higher than without addition of fiber. The mechanical properties of the composite resin with the addition of fibers are influenced by several factors such as the type of fiber used, the number of fibers, the position and the orientation of the fibers, the characteristics of the fiber's surface, the bond between the fibers in the composite matrix, and the absorption of composite matrix.[9]

Addition of bagasse fiber and addition of synthetic fibers proved to increase the flexural strength of the composite resin. Samples without addition of fibers fractured or split into two parts when given the load, while the sample with addition of bagasse fiber and synthetic fiber fractured but the two parts of the sample remains united. This is because the fiber functions in inhibiting cracks. The result of this study is similar with previous research conducted by Mozartha et al., (2014) where the results of the study indicates that the addition of fiber can increase the flexural strength of a composite resin.[3]

The amount of fiber affects the flexural strength. The result of this study is similar with a study by Septommy et al. (2014) in which the addition of one layer of fiber can increase the flexural strength of the composite resin and able to spread the pressure when the load is applied. Flexural strength increases with the addition of fiber on the side of the tension or the side that is pulled. The loaded sample will experience a great pull on the tension side so that the addition of fiber on this side will increase the flexural strength. In a study by Septommy et al., (2014) also obtained a result that states the flexural strength will increase by putting the fiber on the tension side.[10]

The orientation or direction of the fibers also affects the flexural strength of the composite resin.10 Mosharraf and Givechian (2012) suggest that fibers that are laid horizontally or in the direction of the sample length will increase flexural strength compared to fibers that are placed vertically. This is due to the addition of fibers horizontally is in opposite direction to the given force, while the addition of fibers vertically adjacent to the force given so that the results are less efficient.[9]

The characteristic of the fiber's surface is the initial action of adhesion or inter-surface pulling forces which also affect the flexural forces. Characteristic of rough fiber's surfaces cause the inter surfaces bind to the matrix. The binding fibers with the matrix will cause the load to be distributed evenly.[11]

Composite resins with the addition of synthetic fibers have a higher flexural strength compared to composite resins with the addition of bagasse fibers. From the data analysis results showed that there is a significant difference between the flexural strength of composite resin with addition synthetic fibers compared with composite resins with the addition of fiber bagasse. The type of synthetic fibers used in this study isfiberglass and the way to apply it is the same as the bagasse fiber. This type of fiber is made of fine fibers containing glass. In previous studies that also used fiber-type synthetic fibers are proven to increase resistance to high fracture and able to stop crack when the load is given.[12,13]

A significant difference in flexural strength between composite resins with the addition of bagasse fibers and composite resins with the addition of synthetic fibers is due to the lack of strong bond in bagasse fibers between the matrix and the fibers when compared to the matrix bonds with the synthetic fibers. The addition of fibers will not have much effect in increasing the mechanical strength if the bond between the matrix and the fibers is less strong.[14]

The pre-impregnation during the manufacture of synthetic fibers is also one of the factors why the fiberglass fiber has higher flexural strength. Pre-impregnation is a way to increase the effectiveness of wetting the fiber which is by adding PMMA (polymethyl methacrylate) or monomer (acrylate or methacrylate) .[10] This pre-impregnation makes the substance homogeneous and improves the bonds between the fibers so it increases the strength 2 to 3 times more compared to manually impregnated fibers such as bagasse fibers.[13]

Another factor that can cause this to happen is the presence of porosity. Porosity is the trapped air during stirring or molding of samples. Porosity can also be caused by non-proper bind between the fibers and the matrix, as well as moisture contamination, which is the absorption of water from the tools used and even from the material itself during the preparation. Porosity causes the load given is not distributed evenly so this will affect the flexural strength.[11,14]

Based on the result of the research, it can be concluded that the addition of bagasse fiber can increase the flexural strength of the bulk fill composite resin and the mean of flexural strength of the bulk fill composite resin with the addition of bagasse fiber, addition of synthetic fiber and without the addition of fiber are 123,549 Mpa; 144,442 Mpa and 118,125 Mpa.

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