Flexural strength of heat-cured acrylic denture base containing silica from rice husk ash

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Purposes

To evaluate the flexural strength of heat-cured acrylic resin when adding the silica which was synthesized from rice husk ash (RHA) at 1%, 3%, and 5% (wt%) concentrations. Also to compare the flexural strength of heat-cured acrylic resin between incorporated with silica from rice husk ash and commercial silica (Tokusil 233).

Materials and methods

Silica was synthesized from rice husk by acid leaching and calcination and characterized using X-ray Diffraction (XRD), X-ray fluorescence (XRF), and Scanning electron microscope (SEM) to determine the crystallinity, chemical composition and morphology.

A) Acid-treated rice husk

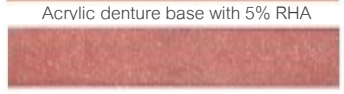
(B) Rice husk ash

Flexural strength test on instron machine

Seventy specimens of heat-cured acrylic resin were prepared according to iso-20795-1: 2013 and divided into seven groups(n=10): control group (unmodified acrylic resin) and six experimental groups which were mixed with silica from rice husk ash and Tokusil 233 into polymethyl-methacrylate powder at 1%,3%, and 5%(wt%) concentrations respectively. The flexural strength test was performed using the universal testing machine (Instron model 4464, England). The data were statistically analysed by by Kolmogorov-Smirnov test and Mann-Whitney U test. Furthermore the fractured surfaces of specimens were observed by SEM.

Control group PMMA

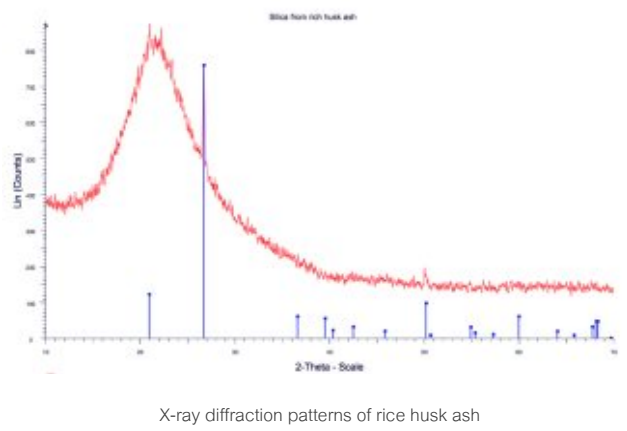
Acrylic denture base with 5% RHA



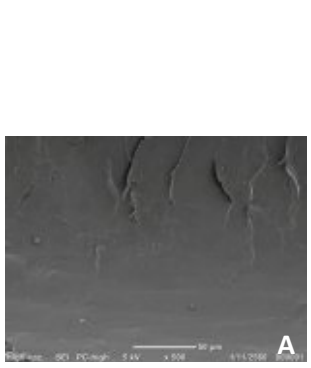
Acrylic denture base with 5% Tokusil 233

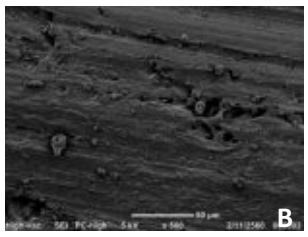
Results

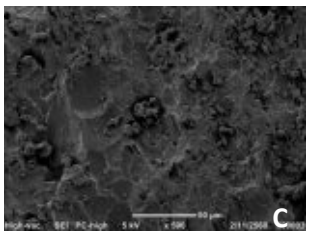
Rice husk ash contained 93.8% SiO2 in amorphous condition, other impurities are metal oxides. The highest flexural strength (120.74 +/- 11.04 MPa) was observed in control group. The flexural strength was significantly decreased as the concentrations of silica increased. Flexural strength of which incorporated with silica from rice husk ash is significantly higher than those incorporated with Tokusil 233 at the same concentration. Agglomeration of silica at fracture surface was observed in SEM micro images, which probably influenced the less homogenous polymer matrix and acted as area of stress concentration which can lead to fracture of denture base.

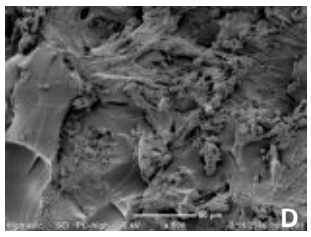


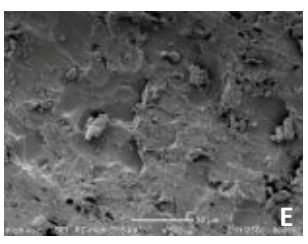
X-ray diffraction patterns of rice husk ash

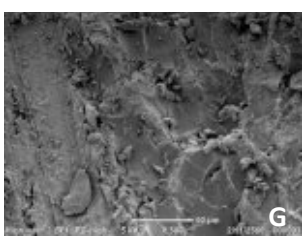


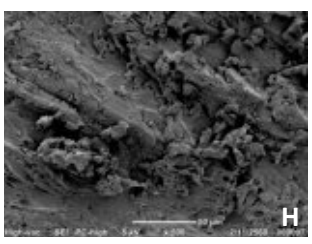




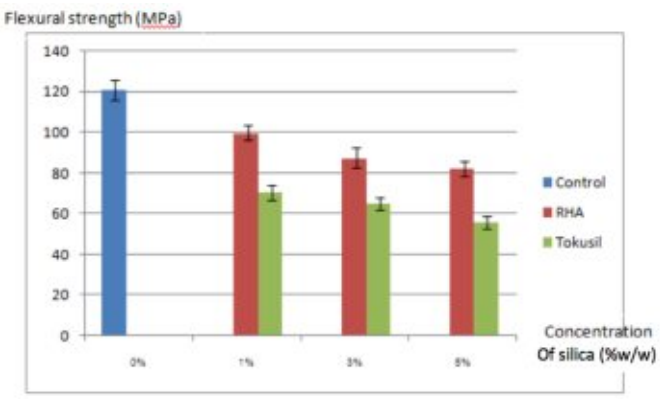








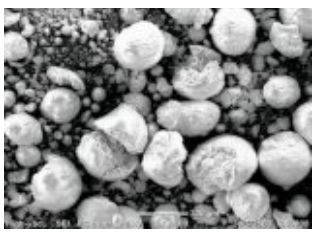
SEM images of fractured surfaces of filled PMMA denture base with different silica concentrations after three point bending test. (A) control group, (B) PMMA with 1% RHA, (C) PMMA with 3% RHA, (D) PMMA with 5% RHA, (E) PMMA with 1% Tokusil 233, (F) PMMA with 3% Tokusil 233 and (H) PMMA with 5% Tokusil 233 addition of silica from rice husk ash.



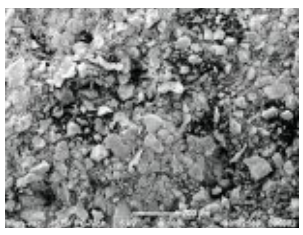
The flexural strength of control PMMA, PMMA with rice husk ash and PMMA with Tokusil 233

Conclusion

The flexural strength of heat-cured acrylic resin denture base was adversely affected by the amount of silica added into polymethyl-methacrylate powder.



SEM image of Tokusil 233



SEM image of rice husk ash

Keywords

Silica, Flexural strength, Heat-cured acrylic