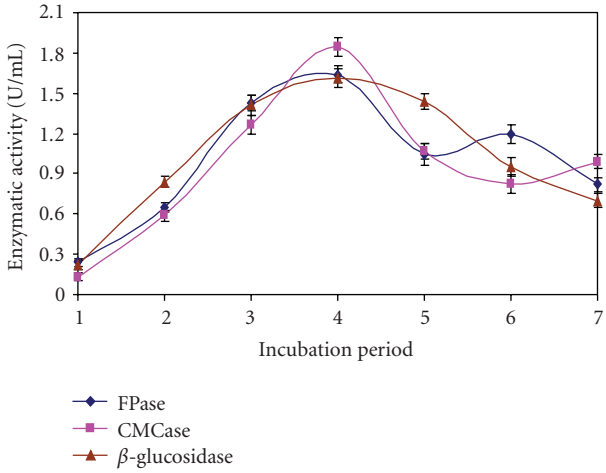

Figure 3: Effect of incubation period on cellulase production (U/mL) by *A. niger*.

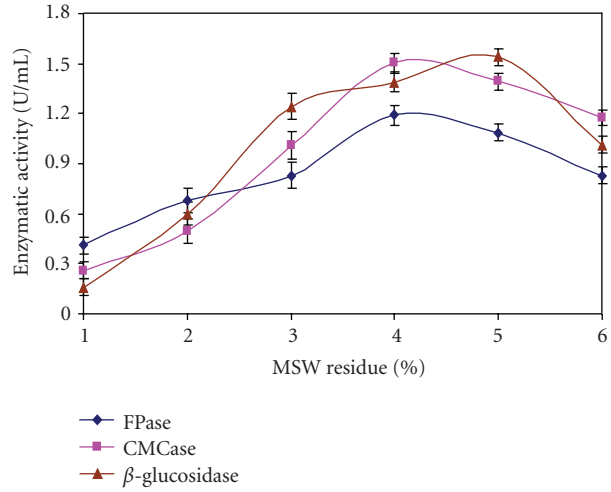

Figure 4: Effect of MSW residue on cellulase production (U/mL) by *A. niger*.

3.2.3. Effect of Incubation Period on Enzyme Production. *Aspergillus niger* was inoculated into basal salt medium in 150 mL conical flask and incubated at 45 ± 2°C for a period of 7 days. The cellulase activity was measured at regular intervals. However, the maximum yield of exoglucanase (1.64 U/mL) and endoglucanase (1.84 U/mL) activity was obtained after 4 days. However, maximum β-glucosidase (1.61 U/mL) activity was shown after 3–5 days incubation in Figures 3 and 7. To determine the optimum incubation period for enzyme production by *Trichoderma* sp., the highest amount of glucose was recorded on 5th day. The incubation period is directly related to the production of enzyme and other metabolic up to a certain extent. *A. niger* and *Trichoderma* sp. showed the most active cellulolytic species along different incubation period. The incubation periods to achieve peak cellulase activity by the isolate *A. niger* and *Trichoderma* sp. were 4th and 6th days which was suitable for commercial point of view [28]. It might be due to the depletion of nutrients in the medium which stressed the fungal physiology resulting in the inactivation of secretary machinery of the enzymes [29].

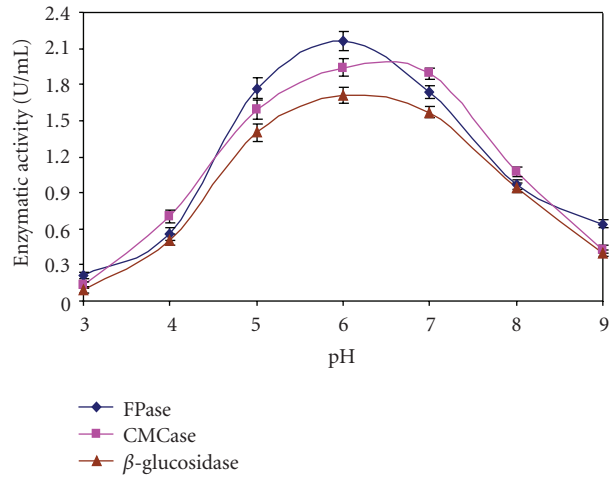

Figure 5: Effect of pH on cellulase production (U/mL) by *Trichoderma* sp.

3.2.4. Effect of Carbon Sources on Enzyme Production. Carbon sources play a vital role in the cell metabolism and synthesis of cellulase. The effect of carbon sources on the production of enzyme by *A. niger* and *Trichoderma* sp. was investigated. Carbon sources tested for production of cellulase enzyme by *A. niger* were glucose, sucrose, cellulose, carboxymethyl cellulose, and maltose ranging from 0.5 to 3.0% (w/v). Cellulose and CMC were found to be the best carbon sources for enzyme production by *A. niger* as shown in Table 1. However, the maximum production of exoglucanase (1.97 U/mL), endoglucanase (1.67 U/mL), and β-glucosidase (2.31 U/mL) was obtained in culture containing 1.0% cellulose. Among the different carbon sources used, the CMC was the second best carbon source (1.0%) for cellulase production by *A. niger* followed by sucrose, glucose, and maltose (Table 1), while sucrose (1.0%) was found to be the best carbon for cellulase production (exoglucanase (2.68 U/mL), endoglucanase (2.17 U/mL) and β-glucosidase (2.06 U/mL)) by *Trichoderma* sp. followed by glucose, cellulose maltose, and CMC. Cellulase production increased with increases in initial sugar concentration from 1.0 to 1.5% (Table 3) while further increases in sugar concentration slightly reduced the yield. Cellulase production increased with increases in initial sugar concentration from 1.0 to 1.5%, while further increases in sugar concentration slightly reduced the yield. Reference [30] also reported that maximum yields of cellulase were obtained on 1% different carbon substrate using *T. viride*. Cellulase production commended on reaching nitrogen-limiting conditions and the yield of cellulase decreased when excess peptone was presented; various inorganic nitrogen sources have been optimized by different workers for cellulase production [22, 31].