ABSTRAK

Keberhasilan proses fermentasi sangat dipengaruhi oleh berbagai faktor selama proses tersebut berlangsung, diantaranya adalah perubahan suhu udara dan ketersediaan udara aerasi selama proses fermentasi. Penelitian ini bertujuan untuk mengevaluasi perubahan suhu fermentasi dan jumlah kebutuhan udara aerasi selama proses fermentasi biji kakao secara autothermal dan isothermal, serta kualitas biji kakao yang dihasilkan dari kedua sistem tersebut. Perubahan suhu udara fermentasi dikendalikan menggunakan mikrokontroler dan data logger, selanjutnya pengendalian udara aerasi dilakukan dengan mengalirkan udara ke dalam tabung reaktor secara terukur menggunakan pompa udara dan *airflow meter*. Fermentasi biji kakao dilakukan selama 5 hari, dengan memvariasikan waktu pemeraman buah kakao sebelum fermentasi, serta pemberian udara aerasi dan suhu udara fermentor selama fermentasi. Evaluasi variasi faktor perlakuan terhadap perubahan suhu udara (suhu puncak dan suhu akhir fermentasi), jumlah kebutuhan udara (*cumulative oxygen uptake* dan *carbon dioxide evolution)*, serta berbagai parameter kualitas fisiko-kimia biji kakao dilakukan menggunakan *response surface methodology (RSM).*

Hasil penelitian menunjukkan bahwa rata-rata suhu udara puncak dan suhu udara akhir pada fermentasi biji kakao secara autothermal diperoleh sebesar 41,33°C dan 27,26°C. Rata-rata jumlah oksigen kumulatif dan rata-rata jumlah pelepasan karbon dioksida kumulatif selama 5 hari fermentasi autothermal adalah 17,37 g O_2/kg_{vs}, dan 27,26 g CO_2/kg_{vs}. Selanjutnya, rata-rata suhu udara puncak dan suhu udara akhir pada fermentasi isothermal diperoleh sebesar 50,05°C dan 44,96°C. Rata-rata jumlah kebutuhan oksigen kumulatif dan rata-rata jumlah pelepasan karbon dioksida kumulatif selama 5 hari proses fermentasi isothermal diperoleh sebesar 17,95 g O_2/ kg_{vs} dan 30,03 g CO_2/ kg_{vs}.

Kondisi optimum fermentasi autothermal diperoleh pada waktu pemeraman buah kakao (Xa_1) 7 hari, laju aerasi (Xa_2) sebesar 0,4 liter/menit.kg, mode aerasi (Xa_3) *intermittent* 2, dengan persentase biji kakao terfermentasi sebesar 77,38%, dan indeks fermentasi sebesar 1,16. Sementara itu, kondisi optimum fermentasi isothermal diperoleh pada waktu pemeraman buah kakao (X_{i1}) 5 hari, laju aerasi (Xi_2) 0,4 liter/menit.kg, suhu udara fermentor (Xi_3) sebesar 50°C, dengan nilai persentase biji kakao terfermentasi sebesar 82,05% dan indeks fermentasi sebesar 1,87. Biji kakao kering fermentasi autothermal dan isothermal secara umum telah memenuhi standar nasional yang berlaku yaitu SNI 2323 2008/ Amandemen 1 2010, kecuali untuk persentase kadar air, karena ada beberapa sampel dengan kadar air > 7,5%. Berdasarkan identifikasi dan evaluasi berbagai parameter diketahui bahwa fermentasi biji kakao secara isothermal memiliki perubahan suhu fermentasi, tampilan pulp dan biji kakao, serta kualitas biji kakao hasil fermentasi yang lebih baik jika dibandingkan dengan fermentasi secara autothermal.

Kata kunci: fermentasi autothermal dan isothermal; pemeraman buah kakao; laju aerasi; suhu fermentor; kualitas biji kakao

ABSTRACT

The success of the fermentation process is greatly affected by various factors during the process, including changes in air temperature and availability of aeration air during the fermentation process. This research aims to evaluate the change in air temperature fermentation and the amount of air aeration demand in autothermal and isothermal fermentation processes of cocoa beans, as well as the quality of cocoa beans produced from the both systems. The changes in the air temperature were controlled by using a microcontroller and data logger, then control of air aeration was carried out by flowing the air into the reactor tube in a measurable manner using an air pump and an airflow meter. Furthermore, the fermentation processes were carried out for 5 days, by varying the ripening time of the cocoa pod before fermentation, as well as the provision of air aeration and air temperature of fermentor during fermentation. Evaluations of variations of treatment factors to the changes of air temperature, amount of air demand, and various quality parameters of cocoa beans were carried out using response surface methodology (RSM).

The results showed that average peak air and final air temperatures in the autothermal fermentation of cocoa beans were 41.33℃ and 27.26℃. The average cumulative oxygen demand and the average amount of cumulative carbon dioxide release during the 5 days of the autothermal fermentation process were 17.37 g O g /kg$_{vs}$ and 27.26 g CO_2/kg$_{vs}$. Average changes in peak and final air temperatures in isothermal fermentation were obtained at 50.05 ℃ and 44.96 ℃. The average cumulative oxygen demand and the average amount of cumulative carbon dioxide release during the 5 days of the isothermal fermentation process were 17.95 g O g /kg$_{vs}$ and 30.03 g CO_2/kg$_{vs}$.

The optimum conditions for the automatic cocoa beans fermentation were obtained when cacao ripening time (Xa_1) of 7day, aeration rate (Xa_2) of 0.4 liters/ minute, and aeration mode (Xa_3) of intermittent 2, with the percentage of fermented cocoa beans at 77.38%, and fermentation index at 1.16. Meanwhile, the optimum conditions for the isothermal fermentation of cocoa beans were obtained at cacao ripening time (Xi_1) of 5 days, aeration rate (Xi_2) of 0.4 liter /minute.kg, and air temperature of the fermentor (Xi_3) of 50 ℃, with a percentage value of fermented cocoa beans at 82.05% and a fermentation index of 1.87. Fermented dry cocoa beans produced in an autothermal and isothermal systems in general have met the national standards, SNI 2323 2008/ Amendment 1 2010, except for the percentage of water content (there are some samples with water contents > 7.5%). Based on the identification and evaluation of various parameters it is known that isothermal fermentation of cocoa beans has a change in fermentation temperature, the appearance of pulp and cocoa beans, as well as fermented cocoa beans better quality when compared to autothermal fermentation.

Keywords: *autothermal and isothermal fermentation; cacao ripening time; aeration rate; fermentor temperature; quality of cocoa beans*