Design Of Prototype Dual-Purposed Vanilla Drying-Fermentation Machine

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Abstract : The main problem of processed vanilla bean is the poor quality. One of causal factor is the lack of appropriate equipment such as dryer, and fermentation equipment. The purpose of This research is to produce an equipment that able to perform both drying and fermenting the raw vanilla beans directly after harvesting that have a good performance. By using this machine it was expected the quality of Vanilla bean will increased. Results shows that the the equipment functioned properly with slow drying rate, the stable temperature, good quality of the dried bean as well as good performance on drying and fermentation processes that can be performed on precise time alternately and automatically.

Keywords: drying, fermentation, vanilla, machine ,work alternately, automatically.

A. Introduction

Vanilla bean processing consists of withering, fermentation, drying and storage (Hardiman and Kartiko, 1980). To obtain a good quality vanilla, then the vanilla water content needs to be lowered through 2 stages, the first stage is the fermentation-drying carried out for 5-10 days (up to about 55% moisture content). The second Stage isaerating vanilla for 30 days (up to 30-35% moisture content) (Hadipoentyanti etal, 2007). Drying and fermentation processes include a very critical phase. Errors that often occur is the vanilla just been dried without fermentation process thus resulted in poor quality (Tombe etal, 2002). It is therefore necessary to design the appropriate equipment for vanilla drying-fermentation, that is a prototype machine that combine fermentation and drying process and that can work alternately and automatically. The research objective is to produce a combined vanilla drier-fermentation equipment that can work automatically. Usefulness of the research is as an alternative for entrepreneurs in improving the vanilla quality.

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B. Research Method

The prototype design ofthe vanilla drying -fermented machine worked into several stages as shown in Figure 1.

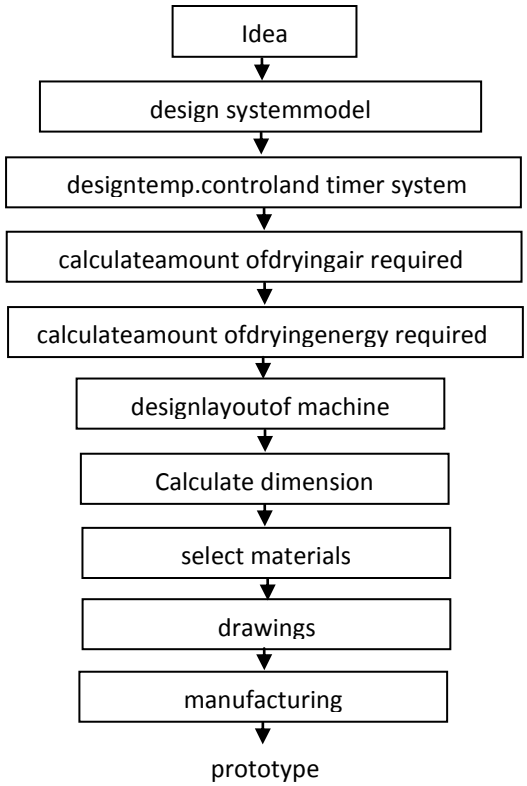


Figure 1. Steps in designing

1. Designing of model

The design results is thesystem model that combinatingthe drying and fermentation process with the control system (Figure 2). Thismodel was then used as the basis for the layout design of the machine parts.

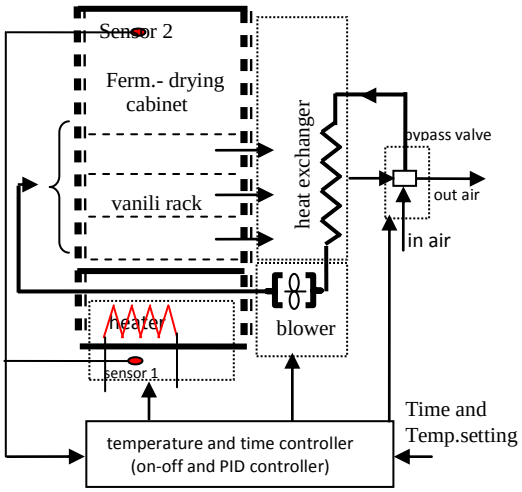


Figure 2.System model ofmachine

2. Design of temperature and time control system

The designed equipment using temperature and time control system to enhance the optimum conditions required in the vanilla processing steps (Fig. 3).

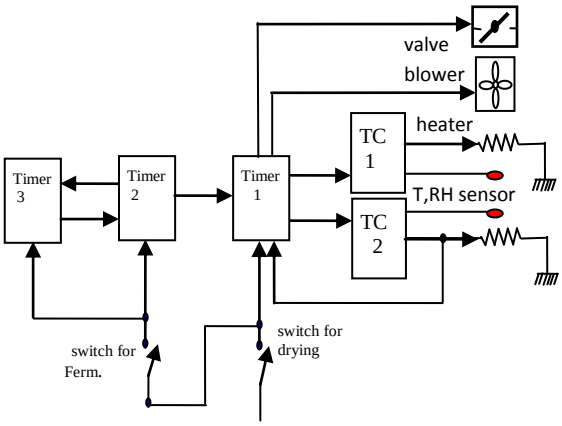


Figure 3. Temperature and time control system.

Time control systems regulate working time of thermocontroller, valves, and blowers while thermocontroller regulate temperature.

3. Dryingair requirement

Based on preliminary research data and the properties of air, hence the need for drying air for 20 kg of vanilla is 56,923 kg/h, or 0.01542 m3/s. Or equivalent to 2.5 inch blower.

4.Requirement for electricity

Based on data, properties of air, vanillamoisture content, target temperature, and design capacity of 20 kg, then theoretical power required for drying is 600 Watts.For applicationpurposes, the energy losses need to be taken into account. According to Waris (2002) thermal efficiency of the dryer that uses heat exchangers and control systems, as well as a walled aluminum with glass wool insulation is 50%. If efficiency of machineis assumed 50%, then power needed for drying is 1200 Watts.

5. Dimension of drying-fermentation machine

Dimension of machine is 65 x 60 x 96 cm (Fig.4). it'sbased on volume of the dried vanilla, insulator, dimensions of blower and heater.

Figure 4. Prototype of vanila drying–fermentation mechine

C. Results and Discussion

1. Performance test without material

a) Air temperature in cabinet

Measurement results (Figure 5) shows that the air temperature in the drying cabinet increased 1.72 °C/min, stable and without overshoot. Rise time is 18 minutes. It indicates that drying machine has enough energy and good performance for the drying and fermentation process.

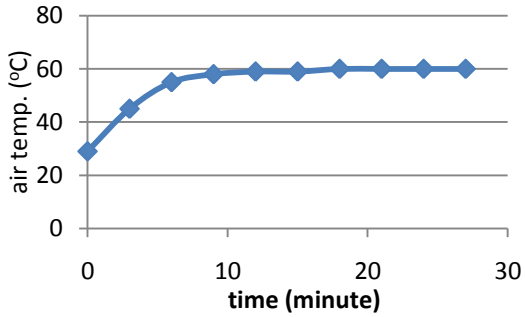
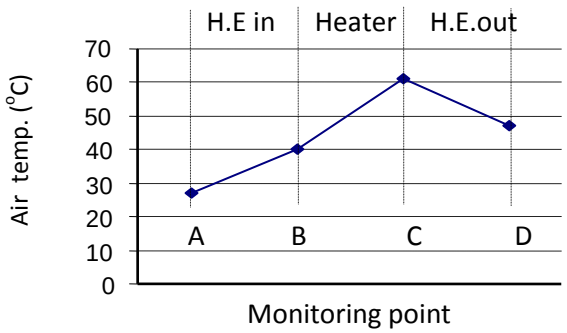


Figure 5. Response of air temperature in cabinet

b) Air temperature in machine parts

Figure 6 shows that after air passing through heat exchanger, air temperature increases 12°C (from 28-40°C) then after passing through heater, temperature rise 20°C (from 40-60°C).



A = air inlet
B = air after passing through heat exchanger
C = air after passing through heater
D = air out after passing through drying cabinet

Figure 6. Profile of air temperature on machine

Furthermore, air that coming out from drying chamber pass heat exchanger. After passing through heat exchanger, the temperature decrease 13°C. This proves that blower, heat exchanger and heater can work properly.

c) Speed the drying air in the rack

Air velocity at rack is varied, but the difference is relatively small, namely 0.03 m/s between middle and lower, and 0.05 m/s between upper and middle. Expected that it cann't influencequality of vanila.

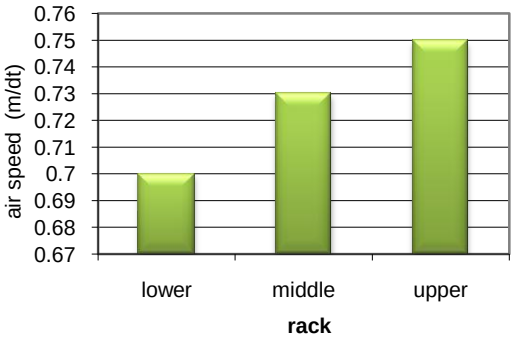


Figure 7. Air velocity at rack

2. Performance test with vanila

a) Air temperature of drying-fermentation process

In Figure 8, it appears that air temperature rises rapidly, within 25 minutes temperature had reached setting point(60°C). After 3 hours of drying, temperature decrease to 40°C and is stable during 21 hours.

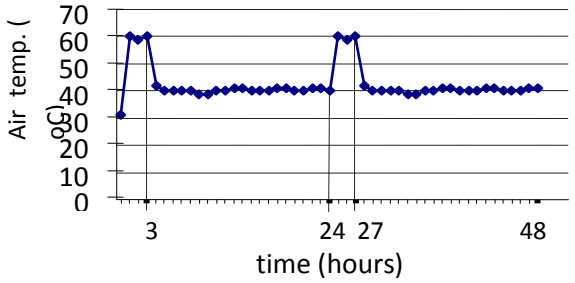


Figure 8. Air temperature in drying-fermentation process.

Also it appears that control system can work with criss-cross at the right time automatically. Those indicate that machine has been designed to work properly.

b) Drying rate of vanilla

Figure 9 shows that rate of water evaporationin drying and fermentation process. Those's average rate are 0.339 and 0.023 kgH_2O/hrespectively. those is quite slow and is very good for processing vanilla at the first stage.

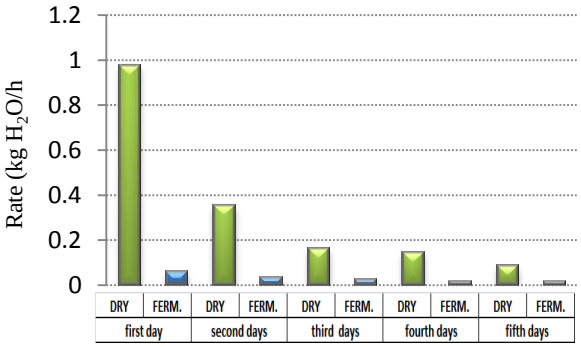


Figure 9. Drying rate of vanilla

c) Moisture content of vanilla

From the monitoring (Fig.10) isknowed that to achieve 54% moisture content, the drying-fermentation process carried out for 5 days (120 hours). This shows that drying-fermentation machine can process vanila slowly, such as those recommended in the processing of vanilla.

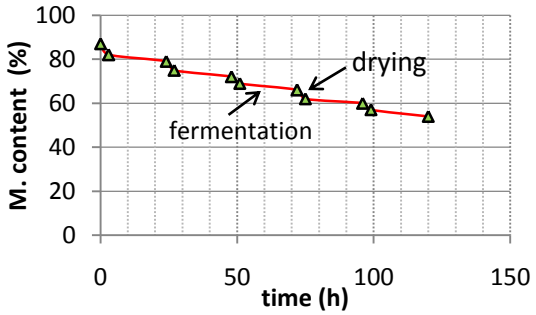


Figure 10. Moisture content decrease during drying and fermentation process

d) Quality of vanilla

After vanilla in drying-fermentation process for 5 days, it's color turned into dark brown, vanilla's aroma was quite strong, and it's elasticity was very good, it can be wrapped around on theone inch pipe (Figure 11),

Figure 11. Results of vanilla drying-fermentation process

D. Conclusion

It has successfully designed prototype of the vanila drying–fermentation mechine that can be used in the processing of vanilla and produce good quality vanilla.

E. REFERENCES

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