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RESEARCH ARTICLE

A DESIGN AND FABRICATION OF ALOE VERA PEELING AND DICING MACHINE

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ABSTRACT

In this research, aloe vera peeling and dicing system is designed and fabricated with high capacity of 5 ton/hr. The system consists of aloe vera fillet, peeling and dicing mechanism. The system is tested for different speed of the roller and leaf thickness. It is concluded that for getting the maximum gel peeling efficiency 98.56%, the system should be carried out at 75 rpm roller speed for 20-22 mm thickness of aloe vera leaves. The dicing efficiency also exhibits high result with mechanism help changing the flexible aloe vera dice size. Moreover, the system also shows the high stability for reaching capacity of 5 ton/hr while running continuously in ten hours.

KEYWORDS

aloe vera peeling, aloe vera dicing, aloe vera machine, aloe vera peeling and dicing machine

1. INTRODUCTION

Aloe vera, also called as a "wonder plan", is a tropical or subtropical plant characterized by lance-shaped leaves with jagged edges and sharp points. It is being got more and more attention from the researchers around the world because of its variable applications in pharmaceutical, food and cosmetic industries and new skin preparation (Eshun and He, 2004; Moore and McAnlley; Leung, 2020; Meadows, 2004). However, due to the limited knowledge of the aloe vera and its characteristics, most of the method for the processing of the plant resulting in the final product that do not consistently achieve desired results. Moreover, many aloe vera peeling machines were fabricated and introduced in the market with low capacity, 0.5-1 ton/hr and many limitations like without filleting margin of aloe vera leaf.

In this research, we successfully develop an automatic system (Figure 1a, b) including automatically filleting, peeling and dicing mechanism (Figure 1c) with high capacity of 5 ton/hr. The system is designed to avoid crushing and reduce manual contact to obtain the good quality of inner from the aloe vera leaves. To the best of our knowledge, this is the first aloe vera peeling and dicing system introduced in Viet Nam.

2. WORKING PRINCIPLE

Aloe vera leaves after being cleaned and trimmed buts and tips will be put on the conveyor-belt. Conveyor-belt and leaf-leading roller make a force and lead the aloe vera leaves follow the direction into fillet mechanism (Figure 2a). After that, aloe vera leaves will be rolled through the peeling mechanism by two parallel rollers rotating in opposite direction and at same speed (Figure 2b). The pair of rollers with variable apertures are arranged to accommodate the varying width and thickness of the aloe vera leaf. By the elasticity of inner gel, the downforce of flexible roller creates rectangular cross section of aloe before coming to rollers (Figure S1). The weight of flexible roller is calculated to satisfy to be enough weight to straighten the aloe leaf. If flexible roller is too light, aloe leaf will not fully contact with the cutter so it will not be peeled completely. Finally, with the dicing mechanism including two rotating rollers (Figure 2c, d), the aloe vera gel will be dicing in both vertical and horizontal direction to get the demand size. Vertical cutters are fitted on the vertical roller and the size of the Aloe dice can be changed by changing the size of the rings between the disk-shape cutters (δ). While horizontal cutters are fitted on the horizontal roller, the size of aloe dice can be changed by changing the distance of cutters or the number of revolutions of roller.

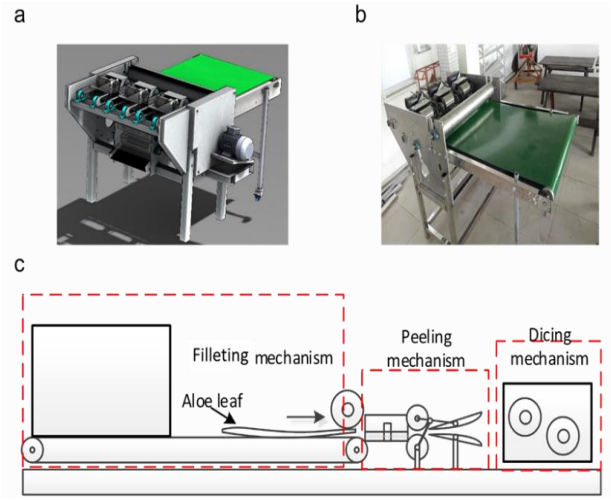

Figure 1: Strategy design of system. Aloe vera peeling and dicing system (a) in modeling, (b) after fabrication and (c) filleting, peeling and dicing mechanisms of the system

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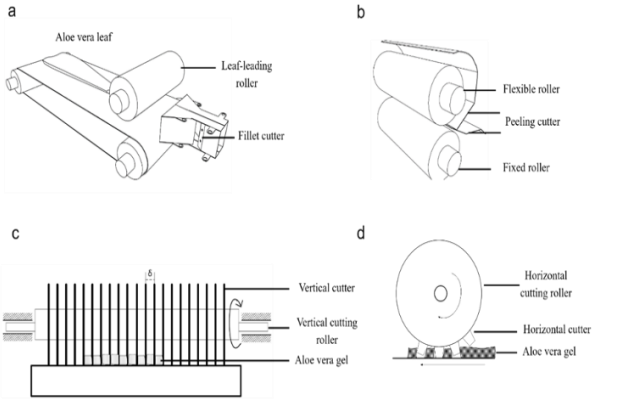

Figure 2: Principle working of Aloe vera peeling and dicing system. (a) Fillet mechanism, (b) peeling mechanism, (c, d) dicing mechanism

3. Characterization

3.1 Peeling efficiency

The peeling efficiency is defined as the ratio of RA to PT: μ= PA/PT.

While PA is the actual gel recovery, determined by the gel obtained by passing the aloe vera leaves through the system. PT is theoretical gel recovery, calculated by the maximum quantity of gel obtained manually.

The peeling efficiency is obtained with the ranges of roller speed from 60 to 135 rpm and with different thicknesses of aloe vera leaf: < 20mm, 20-22mm and > 22mm.

3.2 Dicing efficiency

The dicing efficiency is determined by the ratio of amount of demand size DD to total amount DT: μ = DD/DT from products of 100 aloe vera leaves and the average value is reported (Gajbhiye et al., 2017; Chandegara and Varshney, 2014).

In this research, dicing efficiency is determined with 3 different demand sizes: 4x4x4, 5x5x5 and 6x6x6.

4. Result and Discussion

4.1 Peeling efficiency

It can be seen that the gel after being removed the outer rind is very clean, about 99% (Figure 4a). The maximum peeling efficient of 98.56% is found at the speed of 75 rpm for the leaf thickness 20-22 mm (Figure 4b). While the minimum peeling of 89.05% is obtained at speed of 135 rpm with less than 20 mm leaf thickness. Moreover, as the speed increases from 60 to 75 rpm, the gel peeling efficiency is increased. However, further increase in speed decreases the gel peeling efficiency, due to the contact of the gel and flexible rollers. It is also observed that the mean value of the better leaf thickness greater than 20 mm. Thus, it can be concluded that more the leaf thickness, better will be the gel peeling efficiency.

Comparing with results of some other research, the efficiency of this work shows higher and comparable results (Figure 4c).

4.2 Dicing efficiency

The aloe vera dices with demand size are quite similar (Figure 5a). The results indicate the high efficiency >90% with the size range from 4x4x4 to 6x6x6 (Figure 5b-d). In particularly, the highest efficiency is 93% with the demand aloe vera dice size of 6x6x6 while the lowest ones is 89% for the size of 4x4x4. From these results, the aloe vera dicing is show the most suitable for size of aloe vera dice in 6x6x6 mm to get highest efficiency.

5. Conclusions

The developed aloe vera peeling and dicing system has eliminated the manual contact in processing of aloe vera gel and prevents contamination during peeling and dicing process. In peeing of leaves, the efficiency can reach 98.56% for speed of 75 rpm and leaf thickness of 20-22 mm. The dicing efficiency is also obtained more than 90% with variable sizes. This machine is fabricated by using low cost material available in local market and with capacity of 5 ton/hr. Experimental results shows that the proposed peeling and dicing mechanisms are very efficient and effective so the system could be a choice for many companies working relating to aloe vera.

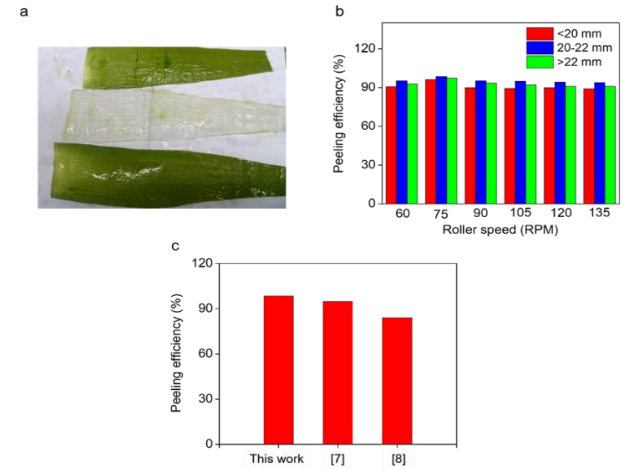

Figure 4: Peeling efficiency. (a) Picture of aloe vera leaf after being peeled, (b) peeling efficiency with different aloe vera thicknesses and roller speeds, (c) comparison of efficiency of this work to other reported works

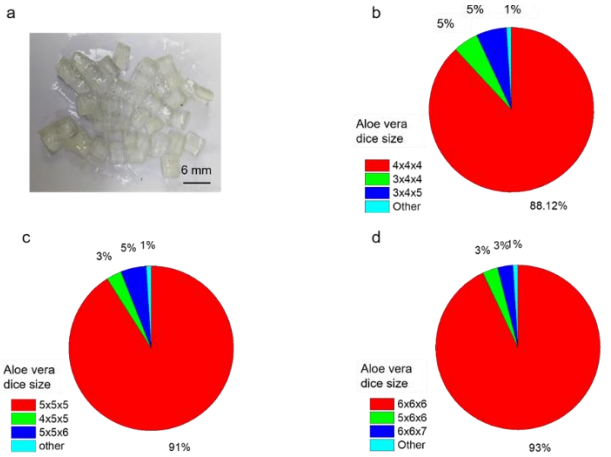

Figure 5: Dicing efficiency. (a) Picture of aloe vera dices with size 6x6x6, dicing efficiency with different demand sizes (b) 4x4x4, (c) 5x5x5, and (d) 6x6x6

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