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Physical Properties Change Due to Pulsed Electric field of flesh Longan

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Abstract

This study evaluated fruits experiencing processing problems in the northern region. It was found that Longan faced the most problems. Farmers needed pretreatment tools to increase processing efficiency and reduce energy consumption costs, while the quality remained the same, pulsed electric field technology was suitable to develop this process. The research team therefore built a pulsed electric field generator that did not use 380/220 grid power, but used photovoltaic as renewable energy to be able to deliver energy. The electric field intensity pulse generator was 14 kV and pretreatment was performed, longan with an electric field intensity of 3 kV/cm under a frequency of 6 /8 10 Hz compared to that of longan that did not undergo a pulsed electric field.

The results showed that Pulse electric field applied to longan As a result, the quality of longan was more suitable for processing by key features was the pressure resistance decreased. The color value appeared to be more pink, when taking longan to examine the cell structure. The cells had to be dried before 2,000 times microscopic examination. It was found that the cells were more porous, varying with the received frequency, where the sample was most energized by the pulsed electric field would be the most porous and of the best quality and when used to measure the pressure resistance and the color appears found to be in good condition and consumers who came to test acceptance. So it could be concluded that the creation of a pulse electric field generator for longan was suitable for expansion to groups of longan farmer, longan processors and other fruits.

Keywords: Photovoltaic technology, Pulsed electric field, Flesh longan

1. Introduction

Thailand is a tropical country and 30% of GDP comes from agriculture[1]. during the period of high productivity Often face the problem of overproduction, oversupply in the market, while in some seasons Some produce is scarce and expensive. Especially perishable fruits, so there are solutions through processing such as soaking, stirring, drying, etc.) But in the process of processing agricultural products, there are still many problems such as using a lot of energy. or constant quality control Including the need to develop technology that helps to produce higher quality processing. Therefore, there are various researches on agricultural product processing.and we can show longan normal property appearance on figure 1a and 1 b

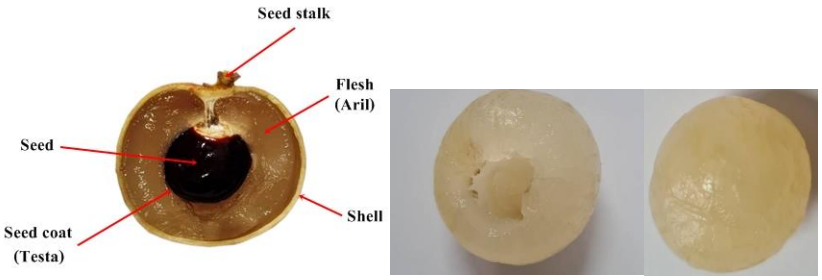

Figure 1a: Longan structure and 1 b :flesh longan

One of the interesting technologies is Using an electric field system to help process perishable fruits such as Kanchana and Viboon (2009) apply microwaves to pretreatment lemongrass before drying ,that research result show that it technology can decrease dryingtime more than 25 percent. whileProduct quality are remain good quality. In addition to the above research There is also a research ofHan-Sol Kim (2022) applied pulsed electric field (PEF) treatment for study was to determine the optimal extraction conditions for extracting the flavonoid quercetin from dried onion skin and to establish whether the yield could be enhanced by combining PEF pre-treatment with an eco-friendly extraction method that uses subcritical water extraction (SWE).The simple can show that Samples of onion skin were treated with PEF under conditions of varying electric field strength 0.5–2.5 kV/cm was then performed with an extraction time of 15 min and at temperatures ranging from 105 °C to 185 °C. Among the conditions tested, the yield of total quercetin was the highest after pretreatment with PEF at 2.5 kV/cm for 15 s Pretreatment with PEF improved the yield of total quercetin extracted by 33.22% compared with the PEF-untreated samples. These findings demonstrate that pretreatment of onion skin with PEF has the potential to improve flavonoid extraction. These findings demonstrate that pretreatment of onion skin with PEF has the potential to improve flavonoid extraction. That can show on figure.2

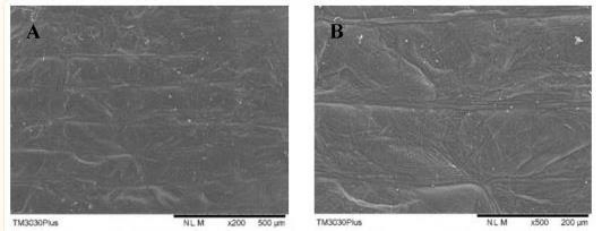

Figure 2 Cell structructure of onion after pretreatment by PEF

Our can describe about PEF are electromagnetic that can extract electron . Induces electrons from the membrane cell causing porosity in the cell can increase efficiency process of product while remain save product on good quality level . we can show process of Pulsed electric field on figure3

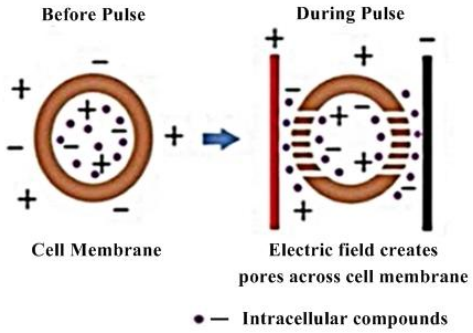

Figure3 Pulsed electric field process on cell

From figure3 after we study about Pulsed electric field process ,Have some research can show result of PEF with agriculture product, Papol Sardyoung[1] applied PEF with immersion process on strawberry .This technology can reduced the immersion time of the strawberry compote with 40 degree Brix.which was less than the traditional treatment that lasts more than 24 hrs.While strawberry are pretreatmented by pulse electric field 150 pulses use time 11 hrs only.That result are show that pef can reduce time in process more thn 56 percent .from previous research result review show that PEF technology is new technology that can solve problems and improve fruit processing. Especially the north area there are fruit that many problem are longan, Farmer need technology to be developed in order to solve problem and achieve higher efficiency, so the research team has select focus on longan to study with PEF ,and jointly designed with entrepreneurs. Build a pulse electric field generator to be part of the development of the longan processing process for better quality.and save energy by photovoltaic cell technology(solarcell).Next step ,purpose to apply technology to farmer on rural area.

2. Purposes

1) evaluate Pulsed Electric Field technology for applied to increase efficiency on fruit processing.
2) Comparative study of changes in physical properties of flesh longan after applying pulsed electric field.

3. Research Methodology

Main methodology on this research are evaluate and select fruit in local area that have big problem and farmer need technology for solve problem and Coordinate with research team in partner company to design and making Pulse electric field prototype machine for research with fruit in laboratory and addition new technology for conserve energy by photovoltaic cell(solarcell system). important description of prototyped PEF machine making , we can describe on description 3.1 an 3.2 topic.

3.1 Equipment & Material

Equipment & Material on this study are consist of 9 important group ,canshow below topic 3.1.1 to 3.1.9

3.1.1 Photovoltaic cell energy source

Pef equipment are consist of

A ; Power Source from photovoltaic group consist of

- Photovoltaic cell 450 va(2-4unit) total 900va
- Maximum power point tracking(MPPT) charger 60A 200V maximum
- DC Surge Protector Device SPD DC 1000V
- Dc fuse / Ground rod
- consumer unit(Din rail type)
- electrical cable(dc) 6 awg
- Miniature breaker(Mcb)

B: Storage energy module

Storage energy module used for store energy from photovoltaic cell and discharge to PEF machine all time .

That section are include

- Batterry cell Lifepo4 66 Ah 3.2V(16 ea). Total 132Ah 24V (3,200 kwh energy)
- Smart Bms & Active balance 16-24 cell (online control typed)
- Digital power meter

Can show instrument on figure 4

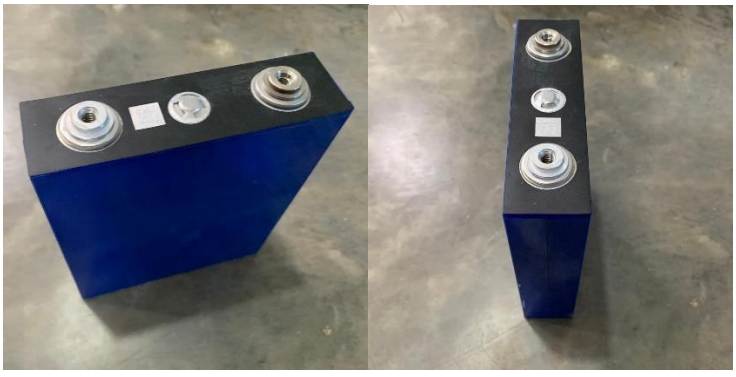

Figure 4 LifePo4 battery

C: transformer and output section

- Hybrid off grid inverter 48V maximum input -3200 kva

AC Surge Protector Device SPD AC385V

- MCCB breaker(ac)
- Surge protection(ac)
- ac fuse & round rod
- consumer unit (Din rail type)

Can show photovoltaic diagram on figure 5

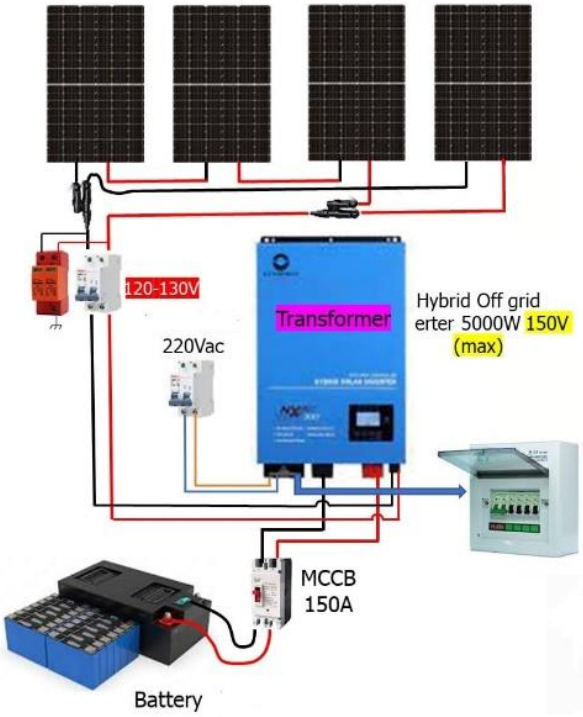

Figure 5 Photovoltaic cell diagram of PEF prototyped machine

3.1.2 Prototyped PEF machine

PEF equipment are consist of 5 main group part A to E group

A: Power Source AC & transformer control group are include

- Variable voltage controller power supply 0-250 Volt (variac) 5KVA
- Residual current operated Circuit Breakers with integral Overcurrent protection for household (RCBO)
- Miniature Circuit Breakers (MCBs) (AC 200v 50Hz)
- electrical cable(dc) VAF 2x2.5 mm.

- Digital voltmeter
- Hi volt transformer 0-250V to 0-14 kV(ac)

B: Power Source DC group are include

- electrical cable(dc) 8 awg
- Hi-volt Power diode
- Hi-volt Capacitor 1 set(total 0.1 micro farad)

C: Pulsed electric field generator section are include

- Power mosfet
- spark gap
- pulsed transformer

D: Chamber section are included

- Electrolde plate
- Chamber(polyethylene)

E: Outer body

Frame body and insulator

Ground rod

And prototyped Pulsed electric fields machine can show on figure6

Figure 6 Pulsed electric fields machine prototyped

3.1.3 Color meter

Color meter used for mesure colour appearance on product.

Figure 7 Color meter

3.1.4 Hot air oven 3000w

3.1.5 Moisture analyzer equipment

3.1.6Digital micrometer Microscope 2000X

3.1.7 Instron testing machine

Instron testing machine used for test test stress of material(longan)

Figure 8 Instron testing machine

3.1.8 Raw material and other measurement

- Longan A size(25.4 mm or more than diameter)
- Thermometer
- Colour meter
- purifier water pH 6.5-7.5

3.2 method

After prepare instrument and equipment on 3.1 topic completed.Researcher team build all material make to solar PEF machine protopyted .can showthat on figure 10.and 11

Figure 10 Photovoltaic energy source

when completed installed solarcell energy source.next step our team installmobility Pulsed electric field 14 kV prototyped follow up by flowchart schematic on figure 11.

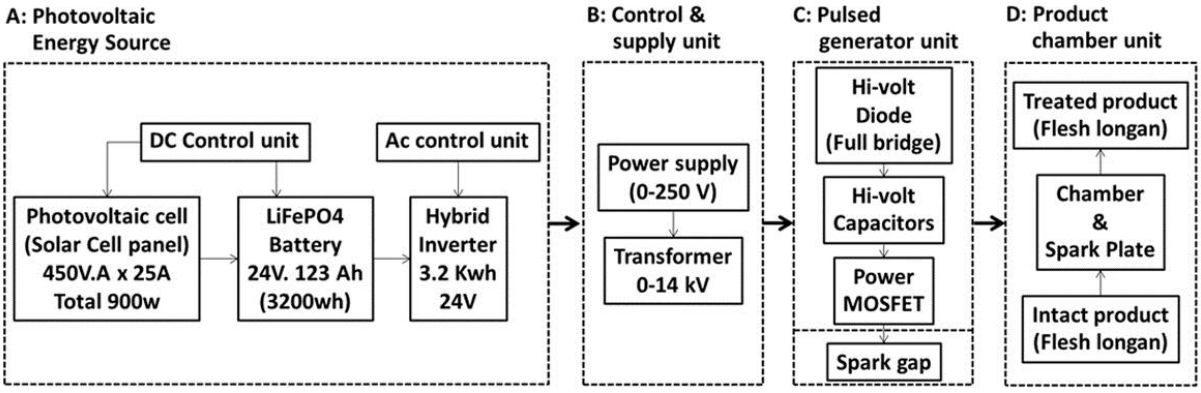

Figure 11 flowchart schematic on figur pulse electric field 0-14 kV prototyped working process.

Detail on Figure 11 ,can show process of PEF prototyped ,resource and process that effect to longan. Firstly Photovoltaic module(SectionA) convert sunlight from sun ,it convert to dc power and storage to Lithium phosphate batery.Hybrid transformer inverter convert energy from Lifepo4 battery to ac power 220 volt level.Electric 220 V(ac) direct to Variable adjustable power supply.on control & supply unit(section B).Researcher can adjust voltage and frequency on this module.and next step, hi volt transformer convert 220V(ac) to 14 kV(ac),this hi volt electric 14 kV are transfer to pulse and generator module unit(section C).When section C module received high voltage from section B. Pulse and generator module unit transfer electric energy14kV (ac) to power diode that are full bridge circuit , it convert input energy from alternating current to direct current (14 kV equal) .When direct electrical convert .Then send power to the capacitor until it is full. The capacitor supplies power to power mosfet and spark gap. When there is enough energy. The spark gap emits a pulse signal. This step generates an electric pulse. When a sufficient number of pulses are emitted will be sent to module D(product & chamber unit).After that ,Pulsed electric field 14 kV transfer to chamber . After that, Fruit product (flesh longan in water) is also pre treatmented by Pulsed electric field electromagnetic power. And cause changes in the exchange of electrons in the cell ,As mentioned in the results section.Longan product in spark chamber are shown on figure 12.

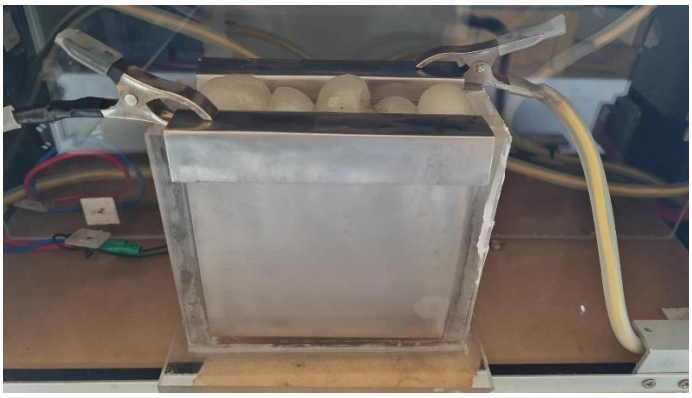

Figure 12 Longan product in spark chamber

After designed parameter and suitable optimizes prototyped completed .Coordinate with research team in partner company design pulse electric field prototype for research with fruit in labolatory to create pulse electric field 0-14 kV and photovoltaic prototyped.Next step are evaluate and select fruit in local area that have big problem and farmer need technology for solve problem

-Test PEF prtotyped with product(longan)with frequency 6 Hz compare with no PEF longan on parameter

- Colour appearance
- Stress
- Water activity
- Cell structure

.-Record and anlysis result on this topic.

- Test again by adjustable frequency increased to 8 Hz and 10 Hz , record and anlysis result.

4. Results

On this study ,important physical properties It consists of 5 important parts for evaluate and analysis about quality of Pulsed electric field technology with longan as below

4.1 Colour appearance

The apparent color value of longan that passed the electric field was measured with the index L ,a* ,b* after pretreatment. The red value was higher than the longan that did not pass the electric field. and vary greatly with increasing frequency. Longans that have passed the 10 Hz electric field have the highest red value. This can be shown in the chart in Figure 11.

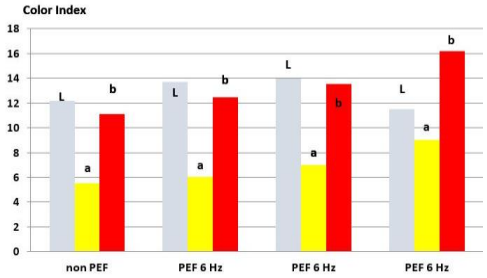

Figure 11 Colour apperance of longan

After get result on colour appearance,test strength of material(stress test) on next step.

4.2 Srength of product

After test colour appearance, to be test strength of material by Instron testing machine ,strength test result that found longan were pre-treatment by Pulsed Electric Field can reduce stickiness and stress.It can be cut more easily Therefore, instron testing machine under stress N found that non PEF longan was the toughest and hardest with a stress of 5.1 MPa. while pretreatment by pulsed electric field longan was softly. able to bear less force easier to cut and varies with the frequency of the electric field .The longan that 6 Hz have stress result increase to 4.7 Mpa ,Especially longan that pretreatment under frequency 8 Hz can reduced stress to 3.8 Mpa,at last longan under pulsed electric field was the softest and easily cut off with the stress reduced to 3.3 Mpa. The results are shown in the compressive stress graph on figure12

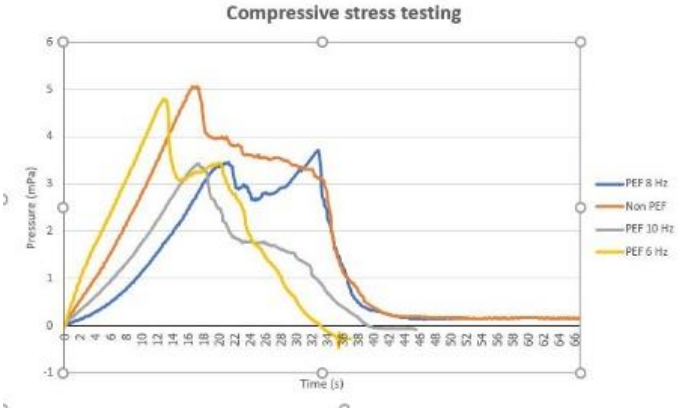

Figure12 longan compressive stress comparative

After testing and knowing the results of longan compressive stress comparison, Water activity(aw) must be measured, but because it cannot be measured from fresh longan. Therefore, the longan has been dried. The humidity is comparable to that of dried longan that is commonly sold in the market. and then tested for water activity (aw).

4.3 Water activity(aw)

In the comparative test for water activity coefficient(aw), it was found that all samples of longan have similar values with similar values, between 0.54-0.56, which meet the requirements of Bureau of Agricultural ommodity Standards [7] which states that Water activity(aw) must not exceed 0.60therefore it is accepted that longan that undergoes the pulsed electric field also meets international standards for water activity as well.

.That result can shown on figure 13

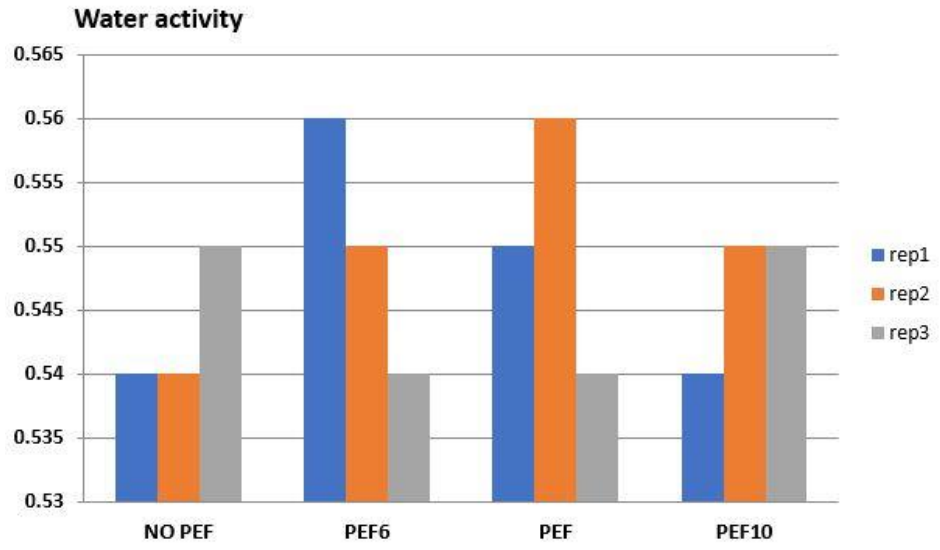

Figure 13 water activity (aw) comparative

4.4 Porosity on cell structure

Upon knowing satisfactory results in all 3 aspects mentioned above in the final step Therefore, longans that have not been exposed to the pulsed electric field and those that have been exposed to the 3-frequency pulsed electric field were examined for cell structure with a 2000x magnification microscope. Before checking Dried longan must be coated with gold metal on a brass tray ,as shown in the figure 14

Figure 14 prepare dried longan before check cell structure

It was found that the amount of porosity in longan was clearly different.The results of the examination with a 2000x magnification microscope are in accordance with the hypothesis. longans non pre treatment by pulsed electric field It has a rather dense cell appearance. Less porous. While Longan are pre-treatment by Pulsed

electric field frequency 6 Hz, porosity more than non PEF longan.EspeciallyLongan are pre-treatment by pulsed electric field at 8 Hz showed more cell wall porosity and Longan were pre-treatment by pulsed electric field at 10 Hz showed the highest cell wall porosity. There is a clear difference. It can be shown porosity on longan cell structure difference as Figure 15a, 15b, 15 c and 15d.

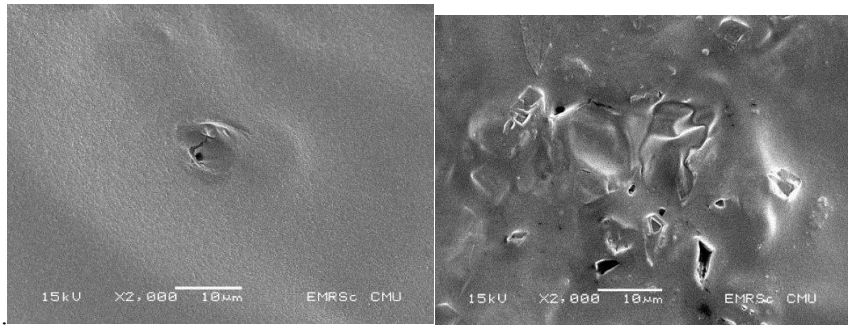

Figure 15a : longan Non-PEF, 15b : longan PEF 6Hz

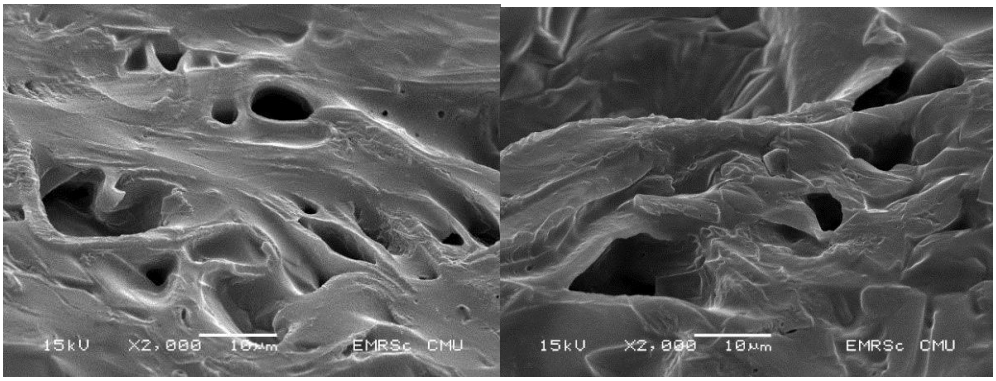

Figure 15 c : longan 8 Hz and 15d.: longan PEF 10 Hz

from the cell structure porosity photographs shown in Figure 15 a,b,c,d.Result are show different on cell.It can describe on next topic.

5. Discussion

Theoretically, The use of Pulsed electric field. Application of an electric field can cause the electron induction of the cell and penetrates the spongy cell wall while remaining intact When the product is processed Will give good results From the experiment, it was found that the results were as expected. Longans pre-treatment by PEF are softer than normal longan. which was shown in clause 4.2 and the color appeared good as clause 4.1 with water activity between 0.54-0.56 which was in line with international standards. directly proportional to the frequency and amount of electric field increased.

6. Conclusions

The research found that The use of photovoltaic solar cells can be used instead of on-grid electricity from power plants. and the introduction of the instrument to create an electric field and bring it to pretreatment to fruits that contain a lot of water can do well. Pre-treatment with electric field It also makes the raw materials softer. and encourage good dehydration This is mainly caused by stimulating the exchange of electrons in the cell membrane. causing pores in the cell wall therefore resulting in good results in many aspects according to the hypothesis . Both in terms of appearance, color, beautiful and valuable, the higher the brightness (L) is proportional to the frequency of the electric pulse field. Decreased pressure resistance Varying with electric field frequency, longans pre-treatment on PEF 3 kV/cm frequency10 Hz had the softest texture.

7. Recommendations

The use of Pulsed electric field technology with longan helps the juicy fruits, especially longans, to be more readily available for processing. This technology can be extended to farmers in the community, including should be extended to rambutan, lychee and pineapple.

8. References

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