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How to Design and Fabricate a Sugarcane Bud Chipping Machine with a Foot Pedal

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ABSTRACT

This Project aims to design and fabricate a Sugarcane Bud Chipping Machine. It has been observed that farmers prefer to plant sugarcane directly in the field manually, which is a cumbersome and time-consuming process. Once the problem was identified, an approach was conceptualized to provide a solution. Sugarcane Bud Chipper which cuts the sugarcane buds in smaller sizes for plantation purposes. These buds are smaller than the sugarcane sticks from earlier plantation methods. This machine incorporates various components, assembled uniquely for a desirable output. The power needed to cut the sugarcane bud is generated from the pedal through human effort. A chain, 137 cm long, was used to link the two sprockets, one was attached to the pedal, while the other sprocket was attached to the arm of the cutting blade. The two sprockets are coupled to two shafts, which transfer force to the arm of the cutting blade. When the pedal is been paddled, mechanical energy leaves the pedal to the cutting unit. The blade holder was attached to the arm of the cutting blade. When the pedal is pressed, the shaft slickly rotates, the cutting unit moves downward and when the pedal is released, the cutting unit returns, upward through the support of the spring. The pedal-powered Sugarcane Bud Chipping Machine is easy to operate and reduces intensive labor. This machine makes operation easier and more comfortable in the process of sugarcane production for rural dwellers who do not have access to a power supply. The use of this machine will improve the economic well-being of local farmers in remote areas.

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1. INTRODUCTION

There are many crops grown by farmers all over the world (Leff *et al*., 2004). These include different food crops, making research on this matter increased (Patle *et al*., 2023; Effiong & Aya, 2022). Crops relate to food sustainability, and much research about food has been published. For example, research on food that is published in one of the food journals is presented in **Table 1**.

Table 1. Current research published in ASEAN Journal of Agricultural and Food Engineering in 2023.

No.	Title	References
1.	The association between the digestive system and liver injury in covid-19 patients	Muhammed *et al*. (2023)
2.	Gender differentials in the agricultural specialization in higher education	Fagbemi (2023)
3.	Anti-inflammatory activity of kalanchoe pinnata (B.Pinnatum) stem extract on acetic acid-induced inflammation in mice (M.Musculus)	Lolos *et al*. (2022)
4.	Development and evaluation of chicken feedstuff using banana (Musa Acuminata X Balbisiana) peel	Peñaflor *et al*. (2022)
5.	Education of dietary habit and drinking water quality to increase body immunity for elementary school	Satria and Nandiyanto (2022)
6.	Citronella (Cymbopogon Nardus) and peppermint (Mentha x Piperita) oil extracts as ant-repelling spray	Lao *et al*. (2022)
7.	Nutrition and dietetics concerning diabetes mellitus: Type 2 diabetes mellitus	Ahsan (2023a)
8.	Nutrition and dietetics concerning diabetes mellitus: Gestational diabetes mellitus	Ahsan (2023b)
9.	Effect of antioxidant compounds on nitrites as inhibitors of N-Nitrosamine formation: A short review	Dewi (2023)
10.	Influence of ICT availability, accessibility, and utilization on agriculture students' academic performance in universities	Makinde *et al*. (2023)
11.	Knowledge of students on about the impact of ice cream consumption on blood sugar	Kususma *et al*. (2023)
12.	Analysis of the effectiveness of the formation and distribution of financial results of business entities engaged in poultry farming	Najimovich (2023)
13.	Unraveling the factors behind the soaring tomato prices: A comprehensive analysis	Ali *et al*. (2023)
14.	Analysis of the application of mediterranean diet patterns on sustainability to support the achievement of sustainable development goals (SDGs): Zero hunger, good health and well beings, responsible consumption, and production	Nurnabila *et al*. (2023)
15.	Efforts to improve sustainable development goals (SDGs) through education on diversification of food using infographic: Animal and vegetable protein	Awalussilmi *et al*. (2023)
16.	Influence of grower agent on growth of bayam (Amaranthus sp.) plants with nutrient film technique in hydroponic system	Salsabila *et al*. (2023)

Sugarcane is one of the highly demanded crops grown across the world (Li & Yang, 2015; Bordonal *et al*., 2018). Sugarcane is a crop of very high value in the production of food and aiding the supply of biomass for fuel crisis resolution (Hidayat *et al*., 2021; Jamilatun *et al*., 2023). It is the most important sugar crop in the world. Presently, it is considered a multi-utility crop useful for producing sugar, ethanol, fiber, co-generation of power, and a host of downstream products. It is one of the crops that will have to be increasingly depended upon by humankind for survival. Hence, growing more sugarcane will be of great concern. Adopting the right and efficient technologies helps in realizing higher yields of cane and sugar. Sugarcane is also the raw material to produce white sugar and jaggery. It is also used for chewing and extraction of juice for beverages. Thus, it is understood that sugarcane has the highest importance among farmers, but due to a lack of proper, efficient, and low-cost technologies, farmers face difficulties during the planting and harvesting of sugarcane, and these problems are largely faced by small-scale farmers who lack funds compared to that of large-scale farmers who have enough monetary resources to adopt and use sophisticated machines for sugarcane cultivation. Therefore, this project focused on providing a machine design that requires low cost to manufacture, is also simple in construction and operation, and benefits small-scale farmers.

The sugarcane planting with the traditional method is costly, time-consuming, and requires great human force and a high volume of sugarcane stalks per hectare. Also, the existing (traditional) tools used for bud chipping of sugarcane are unsafe, messy, and need skill and training. The risk of injury is also high. This necessitates the fabrication of a low-cost sugarcane bud-chipping machine. The traditional method does not have control over the cutting or chipping location. In an uncontrolled cutting or chipping process, 3 to 6 buds set may get planted instead of a single bud. This ultimately results in more population of sugarcane stalks which affects the yield. Sometimes, a cut may appear on the bud as well, which results in no germination of the bud, and we lose the seed. The traditional sugarcane planting methods do not support such facilities. This project deals with solutions to overcome these problems.

The project is justifiable because of the following:

(i) This machine has a high potential for small hand-holding farmers to take out bud from Sugarcane.
(ii) Foot-operated sugarcane bud chipper machine is portable, easy to maintain, and of low cost.
(iii) It is a user-friendly, time-saving technology and easy to implement.
(iv) It is used to chip out the bud from sugarcane for plantation purposes and save more sugarcane sticks.
(v) The novelty of the unit lies in the foot-operated concept and supports less manpower.
(vi) Chipping blade which provides gentle cutting of bud without extra loss of sugarcane during sowing.

The scope of the project is to design and fabricate a pedal-operated Sugarcane Bud Chipping Machine with a human-powered pedal concept which would be useful for local and low-income farmers. This project will be limited to the following points:

(i) To conduct a historical background investigation on sugarcane and currently operating sugarcane bud chipping machines.
(ii) To obtain data that will be used in the selection of suitable materials based on the design methodology and analysis for the fabrication of the machine.
(iii) To obtain a neat and detailed drawing for all parts of the machine for fabrication.
(iv) To have the result of a well-working pedal-operated sugarcane bud chipping machine with every necessary calculation and information of its working principles

2. METHODS

The purpose of this machine is to remove buds from the sugarcane for plantation purposes to minimize losses as well as time, money, and seeds; by pressing the foot pedal the unit removes the bud from the node of the sugarcane, which is then used for planting. The device consists of a platform, pedal, linkage system, and U-shaped chipping blade which is used to chip out the bud from sugarcane for sowing purposes and tissue culture.

The novelty of the unit lies in the foot pedal-operated U-shaped chipping blade which provides gentle cutting of bud without extra loss of sugarcane during sowing. This ultimately generates higher income to the farmer by utilizing the remaining portion of the chipped canes which can be used for making sugar and for any other purpose.

The hemispherical blade is of a radius of 2.5 cm, which chips off the sugarcane buds for the planting purpose.

The vertical displacement of the blade is a result of force transmitted from the chain through a pedal powered by human effort. Figure 3.1 shows the pictorial view of the frame of the sugarcane bud-chipping machine.

A variety of factors were considered before the design of the machine was done. The factors considered include:

(i) The cost and simplicity of the machine
(ii) The return mechanism of the blade after cutting (movement of the blade)
(iii) The height of the machine
(iv) The size and geometry of the sugarcane
(v) The hardness of the sugarcane
(vi) The time required to chip off a bud by a pedal force.

3. RESULTS AND DISCUSSION

The design parameters in the machine have the following points:

(i) The Frame. The frame is a structural metal of 0.5-inch square pipe that supports other components of the machine. It is also the base of the machine and enables the proper balance of the machine for efficient operation (see **Figure 1**). Frame design takes into consideration the upper square dimension with detailed components explained in the following: Length = 76.5 cm; Width = 76.5 cm; The height of the frame, H = 78.5 cm; and The thickness of the pipe, T = 4 cm. Then, the cross-sectional area of the frame is A= W x H = 76.5 cm x 78.5 cm = 6005.25 cm^2.

Figure 1. Photograph image of the Frame.

(ii) Pedal. The pedal is a foot-operated throttle that is used to transmit force through the chain to support the movement of the blade for chipping off the sugarcane bud. The pedal is 48 cm in length and 28 cm in width (See **Figure 2**).

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Figure 2. Photograph image of the pedal.

(iii) The Chain. Here we used a motorcycle chain which is classified as a roller chain. The chain is used for transmitting mechanical force from the pedal to the arm of the cutting blade, which supports a smooth cutting of the sugarcane bud and easy return of the blade. The chain revolves around two supporting sprockets, rotating on a ball bearing for a smooth pedaling operation (see **Figure 3**).

Figure 3. Photograph image of the chain.

(iv) Bearing. There are four 6004RS bearings used in this design, the 6004RS Sealed Ball Bearing has an inner diameter of 20 mm, an outer diameter of 42 mm, and a width is 12 mm. The bearing is made of Chrome Steel, each bearing has 2 rubber seals to protect the bearing from dust or any possible contamination, and bearing is pre-lubricated with grease (see **Figure 4**). Features are in the following: (i) Deep groove geometry for high speeds and supporting both radial and axial loads, (ii) Chrome steel for durability and resistance to deformity under heavy loads, and (iii) Sealed to keep lubricant in and contaminants out. Specifications followed the following considerations = Part Number = 6004RS-BST; Static Load Capacity = 500 Newton; Dynamic Load Capacity = 9400 N; Bore Diameter = 0.787 in; Inside Diameter = 20 mm; Item Diameter = 42 mm; Item Thickness = 12 mm, Item Weight = 2.56 ounces; Material = Steel; and Width = 12 mm.

Figure 4. Photograph image of the 6004RS Sealed Ball Bearing.

(v) Sprocket. There are two 428-14 teeth counter sprockets used in the design of this machine, one is attached to the arm of the cutting blade, while the other is attached to the pedal for smooth pulling of the arm to support the cutting of the sugarcane. It works in tandem with their teeth engaging between the drive chain links. The two sprockets rotate slickly at the same time, the teeth slickly pull the chain causing the rotation of the sprockets and the chain (see **Figure 5**). Specifications are the following: Fit Shaft: 17mm; Distance: 31mm; Tooth Number: 14 teeth; Fit Chain Size: 428 Chain; Material: Steel with hot treatment, long durable; and Item Weight:4.3 ounces. Sprocket Ratio Calculation follows the concept of the number of teeth on the driving sprocket divided by the number of teeth on the driven sprocket. Thus, it follows the value of 1.

Figure 5. Photograph image of the 428-14T Sprocket.

(v) Spring. The function of the spring in this design is to enable the arm of the cutting blade to return to its initial position after cutting. This compression of the helical spring creates some resistance to the compressive force applied axially by the force exerted by the human foot through the pedal (See **Figure 6**).

Figure 6. Photograph image of the helical spring.

(vi) Blade. The blade is a U-shaped blade, this is the major component of the sugarcane bud cutting machine because it does the cutting/chipping of the sugarcane bud. The chipper is used to cut the sugarcane bud and to remove the same size of the sugarcane bud. The blade was made up of a 0.5-inch stainless steel pipe and was cut and grounded in a U-shape to support an efficient detachment of the sugarcane bud (see **Figure 7**).

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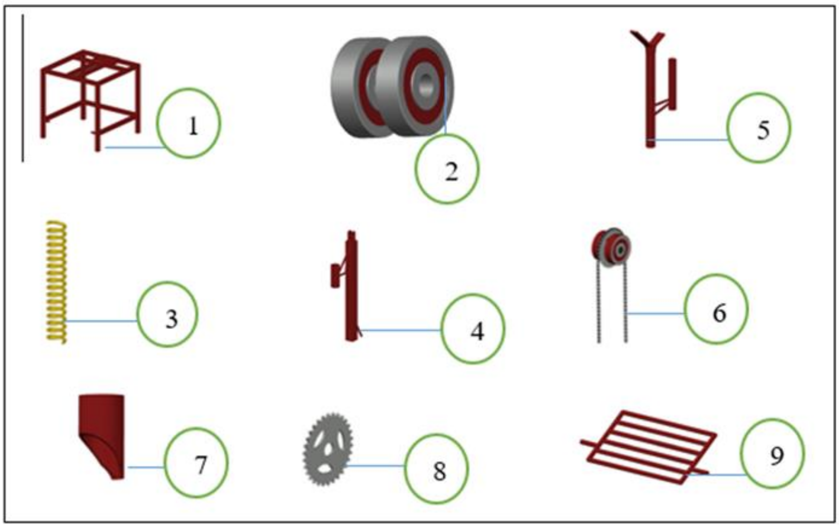
Figure 7. Photograph image of the U-shaped Blade.

To understand cutting energy, calculations must be made. The energy required to drive the processing unit follows Work = Force x distance, and Force = (m) (g). They denote Force as the force applied on the pedal; m is the minimum mass of the end user (weight = 45.3 kg); g is the gravitational constant (9.81 m/s^2). Or we get F = 444.4 N. And, using Work = Force x distance, while D = 0.8 m (cutting distance), we can get W = 355.5 J. Now, considering the factor of safety, and we assume the factor of safety as 2.0, the total energy = (2.0) (0.3555 kJ) = 0.711 kJ. From the result, it is confirmed that the energy required for the chipping of the sugarcane bud is 0.711 kJ.

Detailed components are shown in **Figures 8-11** and **Table 2**. The components contain Frame, Bearing, Spring, Blade arm, Blade holder, Chain, Blade, Sprocket, and Pedal.



Part List	
No.	Part Name
1	Frame
2	Bearing
3	Spring
4	Blade arm
5	Blade holder
6	Chain
7	Blade
8	Sprocket
9	Pedal

Figure 8. Illustration image of the Sugarcane Bud Chipping Machine.

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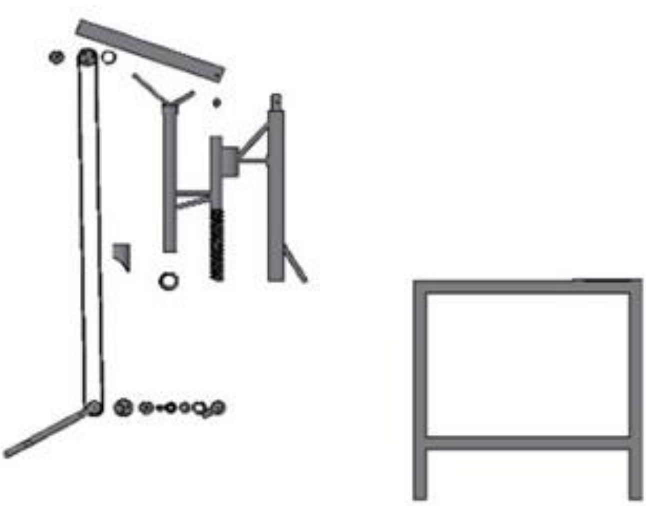

Figure 9. Illustration image of the Sugarcane Bud Chipping Machine.

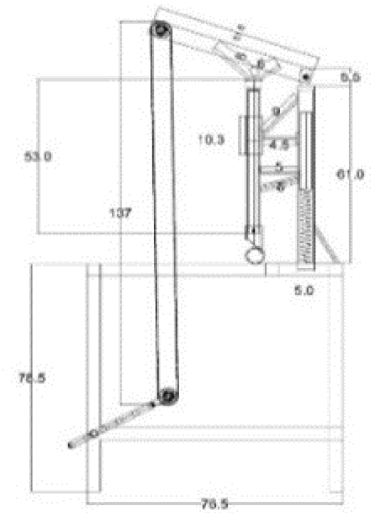

Figure 10. Illustration image of Dimensional view of the Sugarcane Bud Chipping Machine.

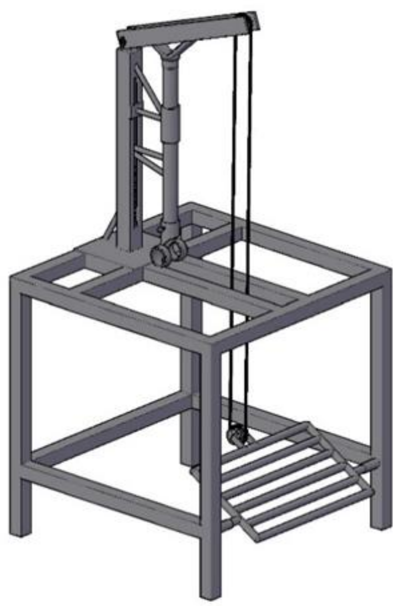

Figure 11. Illustration image of Isometric view of the Sugarcane Bud Chipping Machine.

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Table 2. Material selection for development of the sugarcane bud chipping machine.

No.	Machine Component	Criteria For Selection	Suitable Material	Material Selected	Reason For Selection
1.	Frame	Strength and rigidity	Stainless steel, mild steel, metal galvanized steel	Mild steel square pipe	Low cost and availability
2.	Pedal	Toughness, Lightness, and Strength	Steel rod, flat bar, stainless steel pipe	Steel rod	Formability and weldability
3.	Chain	Strength, lightness and corrosion resistance	Stainless steel, mild steel, carbon steel	Carbon steel	Capability, durability, and affordability
4.	Bearings	Static Load Capacity and rigidity	Bearing steel, stamped steel, cast iron	Cast iron	Low cost, pre-lubricated, and availability
5.	Sprockets	Fit Chain Size, Strength, and Rigidity	Cast iron, carbon steel, stainless steel	Stainless steel	Low cost, durability, and availability
6.	Spring	Strength and Dynamic Load Capacity	Stainless steel, mild steel	Stainless steel	Low cost and availability
7.	Blade	No contamination, strength, corrosion resistance	Stainless steel, cast iron, mild steel	Stainless steel	Low cost, capability, and availability
8.	Pipe (Square & round)	Strength, rigidity, and corrosion resistance	Stainless steel, mild steel	Stainless steel, mild steel	Relatively low cost, and Durability
9.	Metal sheet	Strength, rigidity, and capacity	Stainless steel, mild steel, cast iron	Stainless steel	Availability and Durability
10.	Bolts and nuts	Strength and rigidity	Mild steel	Mild steel	availability

The fabricated machine was tested (see **Table 3**). The energy required to chip the sugarcane bud is generated by the motion of the machine pedal. A chain, 137 cm long, was used to link the two sprockets, one is attached to the pedal, while the other sprocket is attached to the arm of the cutting blade. The two sprockets are coupled to two shafts, which transfer force to the arm of the cutting blade. When force is applied to the pedal, mechanical energy is transmitted from the pedal to the cutting unit. The blade holder is attached to the arm of the cutting blade. When the pedal is pressed, the shaft slickly rotates, the cutting unit moves downward and when the pedal is released, the cutting unit returns, upward through the support of the spring. On the shafts, there are bearing couplings, which were used to reduce the friction, and thus enable a slight movement of both shafts. The movement is not a rotation because the pedal does not transmit a complete cycle of rotational force about the axis of the sprocket. The chain was used as the linkage between the pedal and the arm of the cutting blade. The lubricated chain supports a reduction in friction and causes a smooth movement of the pedal which supports a proper cutting of the sugarcane bud. Thereafter, the sugarcane was fully loaded into the machine. The test was repeated four more times for the different types of sugarcane and the cutting time of the sugarcane was recorded for each

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batch. **Table 3** shows the results of the performance tests. The test was carried out using sugarcane and a stop clock.

Table 3. Results of the performance test on the fabricating machine.

Number of buds cut	Number of uncut (damaged) buds	Cutting time (sec)	Cutting efficiency %
12	3	60	80.00
11	3	58	78.51
10	1	56	90.91
12	2	61	85.71
12	4	63	75.00

The efficiency of the sugarcane bud chipping machine can be defined as the ratio of the number of buds cut to the total number of buds on the sugarcane. The total number of buds is obtained by adding the number of buds cut to the number of uncut (damaged) buds remaining on the sugarcane after cutting. The cutting efficiency was calculated by dividing the number of buds cut by the total dimension (i.e. the number of buds cut and the number of uncut (damaged) buds remaining on the sugarcane after cutting. For the performance evaluation, five sugarcanes were selected. The results showed that the cutting efficiency from trials 1, 2, 3, 4, and 5 was 80; 78.51; 90.91; 85.71; and 75%.

4. CONCLUSION

The sugarcane chipping machine has been fabricated using locally sourced materials. The machine was fabricated in a special way that it could fit into the sugarcane planting strategist. The machine is powered by a human foot. The chipping machine gave sugarcane chips with a length of 1.52 m in 60 seconds, therefore, giving an overall chipping efficiency of 82.026%. The sugarcane bud chipping machine is very useful to small-scale farmers in planting sugarcane buds. Also, time is saved by this process as compared to the traditional system of sugarcane bud planting. The extra pieces of sugarcane bud waste in a small-scale farm can be saved by using a sugarcane bud-cutting machine that can be used as fodder for animals. This new concept in terms of human human-powered pedal is applied for the sugarcane bud chipping process which is suitable and viable and reduces human effort compared to other operated machines. This machine provides comfort for seating arrangements for different positions depending upon ergonomics.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

6. REFERENCES

Ahsan, M. (2023a). Nutrition and dietetics concerning diabetes mellitus: Type 2 diabetes mellitus. *ASEAN Journal of Agricultural and Food Engineering*, *2*(1), 39-44.

Ahsan, M. (2023b). Nutrition and dietetics concerning diabetes mellitus: Gestational diabetes mellitus. *ASEAN Journal of Agricultural and Food Engineering*, *2*(2), 45-52.

DOI:
p-ISSN: 2828-920X e-ISSN: 2828-9951

Ali, M. A., Kamraju, M., and Sonaji, D. B. (2023). Unraveling the factors behind the soaring tomato prices: A comprehensive analysis. *ASEAN Journal of Agricultural and Food Engineering*, *2*(2), 85-104.

Awalussillmi, I., Febriyana, K. R., Padilah, N., and Saadah, N. A. (2023). Efforts to improve sustainable development goals (SDGs) through education on diversification of food using infographic: Animal and vegetable protein. *ASEAN Journal of Agricultural and Food Engineering*, *2*(2), 113-120.

Bordonal, R. D. O., Carvalho, J. L. N., Lal, R., De Figueiredo, E. B., De Oliveira, B. G., and La Scala, N. (2018). Sustainability of sugarcane production in Brazil. A review. *Agronomy for Sustainable Development*, *38*, 1-23.

Dewi, N.S. (2023). Effect of antioxidant compounds on nitrites as inhibitors of N-Nitrosamine formation: A short review. *ASEAN Journal of Agricultural and Food Engineering*, *2*(2), 53-60.

Effiong, J.B., and Aya, C.F. (2022). Rural-urban migration among women farmers: Science education, survey, and implication for food crop production in Cross River State, Nigeria. *Indonesian Journal of Teaching in Science*, *2*(1), 75-80.

Fagbemi, O. M. (2023). Gender differentials in the agricultural specialization in higher education. *ASEAN Journal of Agricultural and Food Engineering*, *2*(1), 9-12.

Hidayat, A., Kurniawan, W., and Hinode, H. (2021). Sugarcane bagasse biochar as a solid catalyst: From literature review of heterogeneous catalysts for esterifications to the experiments for biodiesel synthesis from palm oil industry waste residue. *Indonesian Journal of Science and Technology*, *6*(2), 337-352.

Jamilatun, S., Aziz, M., and Pitoyo, J. (2023). Multi-distributed activation energy model for pyrolysis of sugarcane bagasse: Modelling strategy and thermodynamic characterization. *Indonesian Journal of Science and Technology*, *8*(3), 413-428.

Kusuma, R.A., Sauma, S., Pradiva, F.T., Damayanti, W., and Lushinta, I.P. (2023). Knowledge of students on about the impact of ice cream consumption on blood sugar. *ASEAN Journal of Agricultural and Food Engineering*, *2*(2), 71-76.

Lao, G.M., Dasmariñas, H.A.Q., Nangcas, J.M.M., Luna, M.M., Perocho, S.N.S., Valdez, A., and Fegarido, J.E. (2022). Citronella (Cymbopogon Nardus) and peppermint (Mentha x Piperita) oil extracts as ant-repelling spray. *ASEAN Journal of Agricultural and Food Engineering*, *2*(1), 33-38.

Leff, B., Ramankutty, N., and Foley, J. A. (2004). Geographic distribution of major crops across the world. *Global Biogeochemical Cycles*, *18*(1), GB1009.

Li, Y. R., and Yang, L. T. (2015). Sugarcane agriculture and sugar industry in China. *Sugar Tech*, *17*(1), 1-8.

Lolos, A. M., Maglasang, A. P., Segur, E. M. L., Falsario, M. N. J. S., Lacorda, N. S., and Abusama, H. S. (2022). Anti-inflammatory activity of kalanchoe pinnata (B.Pinnatum) stem extract on acetic acid-induced inflammation in mice (M.Musculus). *ASEAN Journal of Agricultural and Food Engineering*, *2*(1), 13-18.

Makinde, S. O., Olorunnisola, S. K., and Adeyemi, S. A. (2023). Influence of ICT availability, accessibility, and utilization on agriculture students' academic performance in universities. *ASEAN Journal of Agricultural and Food Engineering*, *2*(2), 61-70.

Muhmmed, M. I., Abdul-Razaq, A. S., Mahdi, S. M. (2023). The association between the digestive system and liver injury in covid-19 patients. *ASEAN Journal of Agricultural and Food Engineering*, *2*(1), 1-8.

Najimovich, B. B. (2023). Analysis of the effectiveness of the formation and distribution of financial results of business entities engaged in poultry farming. *ASEAN Journal of Agricultural and Food Engineering*, *2*(2), 77-84.

Nurnabila, A. T., Basnur, J., Rismayani, R., Ramadhani, S., and Zulhilmi, Z. (2023). Analysis of the application of mediterranean diet patterns on sustainability to support the achievement of sustainable development goals (SDGs): Zero hunger, good health and well beings, responsible consumption, and production. *ASEAN Journal of Agricultural and Food Engineering*, *2*(2), 105-112.

Patle, S. K., Parasar, C., and Chavan R. (2023). Study of flood variation of Wainganga River basin and Dhuti dam with impact on crops at Balaghat Station (India). *ASEAN Journal of Science and Engineering*, *3*(2), 199-206.

Peñaflor, L. L., Duldulao, S. L., Villamayor, D. J. F., Dañozo, J. J. L., and Malaco, A. C. (2022). Development and evaluation of chicken feedstuff using banana (*Musa Acuminata X Balbisiana*) peel. *ASEAN Journal of Agricultural and Food Engineering*, *2*(1), 19-24.

Salsabila, Q., Adnin, J., Rochania, T. K. F., and Hibatulloh, A. Y. (2023). Influence of grower agent on growth of bayam (Amaranthus sp.) plants with nutrient film technique in hydroponic system. *ASEAN Journal of Agricultural and Food Engineering*, *2*(2), 121-128.

Satria, R. D., and Nandiyanto, A. B. D. (2022). Education of dietary habit and drinking water quality to increase body immunity for elementary school. *ASEAN Journal of Agricultural and Food Engineering*, *2*(1), 25-32.