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AESAP 2021

The 4th International Conference on
Agricultural Engineering for Sustainable Agricultural Production

"The Role of Agricultural and Biosystem Engineering to provide and manage Food, Land, Water, and Bioenergy to achieve Sustainable Development Goals (SDGs) toward Industry 4.0"

Hosted by Department of Mechanical and Biosystem Engineering, IPB University, 11-13 October 2021

Important Dates

- **July 30, 2021** — Deadline for abstract submission
- **August 12, 2021** — Notification of abstract acceptance
- **September 12, 2021** — Deadline for full paper
- **September 19, 2021** — Notification of full paper acceptance
- **September 26, 2021** — Deadline for registration payment and publication fee

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Heavy metals analysis (Cd, Pb, Zn, Cu, Cr) and calcium in Padang and Padang Panjang fresh cow’s milk

by Rera Aga Salihat

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Heavy metals analysis (Cd, Pb, Zn, Cu, Cr) and calcium in Padang and Padang Panjang fresh cow's milk

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Abstract. Cow's milk is important in a healthy food intake because of its high calcium content. However, the contamination in milk can be harmful to health. The acidity of cow's milk decreases with the increase of heavy metals concentration that is poisonous to the body. This research aims to investigate the content of heavy metals (Cd, Pb, Zn, Cu, Cr) and minerals Ca contained in fresh cow's milk samples from two different locations, which are Padang city and Padang Panjang city. The heavy metal content in fresh milk from these two places has never been tested. The quantitative method used in this research is Atomic Absorption Spectroscopy (SSA). The average heavy metal and Ca minerals contained in samples of fresh milk from the Lubuk Minturun area are: cadmium (Cd) not detected, lead (Pb) 13.58±1.01 ppm, zinc (Zn) 28.83±1.81 ppm, copper (Cu) 1.17±0.38 ppm, chromium (Cr) not detected, and calcium (Ca) 674.00±2.46 ppm. Meanwhile, fresh milk samples from Padang Panjang area: cadmium (Cd) not detected, Pb 20.58±2.02 ppm, Zn 53.08±2.40 ppm, Cu 2.17±0.38 ppm, chromium (Cr) not detected, and Ca 504.25±2.63 ppm. All samples from both regions showed heavy metal content of Pb, Zn, and Cu which exceeded the maximum limit set by the Environmental Protection Agency (EPA), consequently it could cause negative impacts on health when consumed. This is assumed to be caused by cattle food contamination by garbage and pesticides which requires further research.

1. Introduction

Citizen population growth and improvement in income that is followed by public awareness on the importance of a healthy lifestyle cause an increase in demand for fresh and processed cow's milk. Demand for milk is growing rapidly, this can be seen from Based on data from BPS (Statistics Central Bureau) data in the year 2021, the level of milk consumption per capita of the Indonesian people in 2020 is 16.27 kg/capita/year, it has increased by 0.25 percent from 2019. This makes milk to become an economic commodity that has strategic value.

Milk is considered a complete food because it contains essential nutrients including protein, essential fatty acids, lactose, vitamins, and minerals in balanced proportions [1]. However, milk can also contain chemical hazards and contaminants, which are technological risk factors for dairy products, for the associated commercial image, and most importantly, for consumer health [2]. One group of hazardous chemicals that can contaminate fresh milk are heavy metals.

In the periodic table, elements with a high atomic number and are metallic at room temperature are referred to as heavy metals. These metals have a gravitational force exceeding 5 g/cm3 [3]. Most of the heavy metals are toxic to living things if they accumulate in the body even at low concentrations [4] [5].

Generally, heavy metal contamination is infected from environmental sources such as soil and water or feed consumed by animals. In addition, metals in the composition of machinery and equipment used during milk storage and processing may leach into the product during milking [6].

When heavy metals enter the human body through different sources, it affects the cellular functions leading to metal poisoning. Some are excreted through the liver or kidneys or spleen, but some metals accumulate in some excretory organs and cause organ damage.

Heavy metals also cause food contamination which is one of the main reasons for maintaining food safety concerns. Major food contaminants include pesticides, toxins along heavy metal contamination [7]. Heavy metals can accumulate in appreciable amounts in crops such as rice, grasses, and some types of legumes for animal feed, including dairy cattle [8].

Lead and cadmium residues in milk are of particular concern because they are mostly consumed by infants and children. Food is the main route of lead and cadmium exposure in the general population (representing >90% of total Cd intake in non-smokers), although inhalation can be a major cause in highly contaminated areas [9]. Lead and cadmium are considered potential carcinogens and are etiologically associated with several diseases of the cardiovascular system, kidneys, nervous system, blood, and skeletal system. Heavy metals that enter the body through food, in addition to disrupting the nervous system, paralysis, and premature death, can also reduce children's intelligence levels [10].

Contamination of copper metal in foods initially occurred due to excessive use of fertilizers and pesticides[8]. The maximum limit for the copper metal in drinking water set by the EPA is 1.3 ppm. However, copper is a constituent that must be present in the human diet and is needed by the body (Acceptance Daily Intake/ADI = 0.05 mg/kg body weight). At this level, there is no accumulation in the normal human body. However, the intake of large amounts in the human body can cause acute symptoms.

Sensitive organs that are the main targets of heavy metals are soft tissues, such as the kidneys, liver, and central nervous system. Accumulation of heavy metals in dairy animals harms health and processed production. Heavy metal contaminants enter animal systems due to pollution of air, water, soil, and consumption of contaminated feed; Improper manufacturing practices and use of contaminated equipment also contribute to milk contamination with heavy metals [4], [11], [12]. Heavy metals that can be transferred from livestock machinery and equipment are Cu, Zn, Cd, and Pb [13].

Because of the rapid developments in industry and agriculture, the assessment of heavy metal contamination in fresh milk and its derivatives has become very important [14]. This also applies in the city of Padang and Padang Panjang. The purpose of this study was to determine the metal content of Lead (Pb), Zinc (Zn), Copper (Cu), Cadmium (Cd), Chrom (Cr), and Calcium (Ca) in pure cow's milk from two different locations.

2. Methodology

2.1. Sample Collection

Samples of fresh cow's milk were obtained from dairy farms located in two different locations, which are: Lubak Minturun in Padang City and Padang Panjang City to determine the levels of Lead (Pb), Zinc (Zn), Copper (Cu), Cadmium (Cd), Chrom (Cr) and Calcium (Ca) using the Atomic Absorption Spectrophotometry (SSA) method in the Chemistry laboratory of LL Dikti Region X, Padang, West Sumatra.

2.2. Sample Preparation

Fresh milk samples (5 mL or g) were destructed with a mixture of nitric acid and perchloric acid (HNO_3: $HClO_3$ = 4:1 v/v) until a transparent solution was obtained [15]. After digestion, the sample is filtered and diluted to a predetermined concentration. Standard solutions of Pb, Zn, Cu, Cd, Cr, and Ca were prepared by diluting certified standard solutions to the desired concentration. All reagents used are analytical reagent grade. Very high purity water is used for all dilutions. All glass and plastic items were washed and stored overnight in a 10% (v/v) nitric acid solution. After that, it is rinsed thoroughly with ultrapure water and then is dried.

2.3. Sample Analysis

Standard solutions with concentrations of 10 ppm, 20 ppm, 30 ppm, 40 ppm, and 50 ppm were measured using an Atomic Absorption Spectrophotometer at a wavelength and a cathode lamp according to the metal to be analyzed. The standard curve is made by plotting the absorbance value against the concentration of the solution (ppm). The same treatment was also used in the solution of fresh cow's milk samples.

2.4. Statistic analysis

Concentrations of all metals are reported as mean±SD. Each metal was analyzed at least three times for each sample.

3. Results and Discussion

The concentrations of heavy metals (Cd, Pb, Zn, Cu, Cr) and calcium contained in fresh milk samples from two different farm locations, namely: Lubuk Minturun Padang (LM) and Padang Panjang (PP) are shown in Table 1. Maximum metal limits The weight reference in this article is the Maximum Contaminant Level (MCL) set by the World Health Organization (WHO) in Geneva, Switzerland. The unit used is ppm which is equivalent to mg/Kg.

Table 1. Heavy metal and calcium concentrations of fresh milk samples from two different locations

Metal	LM (ppm)	PP (ppm)	MCL by WHO (ppm)
CD	ND	ND	0.005
Pb	13.58±1.01	20.58±2.02	0.02
Zn	28.83±1.81	53.08±2.40	5
Cu	1.17±0.38	2.17±0.38	1.3
Cr	ND	ND	0.1
Ca	674.00±2.46	504.25±2.63	-

*Mean±SD; *ND:Not Determined; ND means <LOD
*LM: Lubuk Minturun Area *PP: Padang Panjang Area
*MCL:Maximum Contaminant Level

Cadmium (Cd)

Cadmium contamination (ppm) of fresh milk samples from two different farm locations was not detected as can be observed in Table 1. This proves that the soil and water that are the source of dairy cattle feed are not contaminated by cadmium. In addition, the livestock equipment used also does not contain cadmium which can contaminate the fresh milk produced. The maximum limit for cadmium contamination in milk set by WHO is 0.005 ppm. From Figure 1, it can be concluded that fresh milk from Lubuk Minturun and Padang Panjang farms is free from cadmium contamination which can cause poisoning if consumed. Acute symptoms of cadmium poisoning are chest tightness, dry throat and chest tightness, shortness of breath, gasping for breath, distress, and can progress to pneumonia,[8]. Prolonged accumulation of cadmium in excretory organs can cause organ damage and also cause changes in cellular function. Continuous long-term exposure can even cause cancer [16].

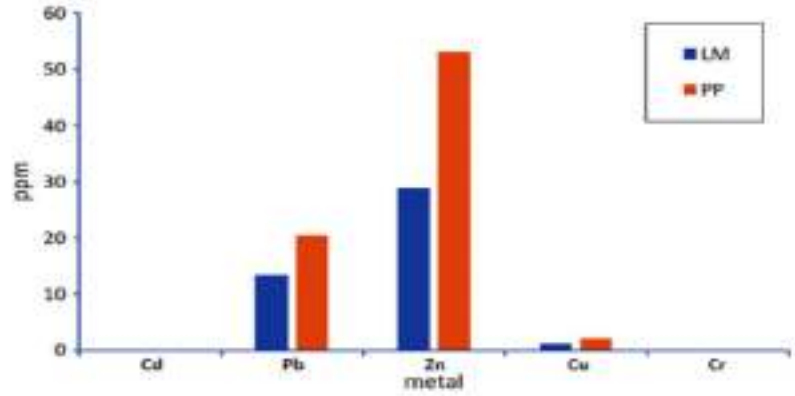

Figure 1. Heavy metal concentrations of fresh milk samples from two different locations (LM and PP).

Lead (Pb)

The lead content in fresh milk samples from Lubuk Minturun (LM) detected was 13.58±1.01 ppm, while the lead contained in the sample from Padang Panjang was 20.58±2.02 ppm as can be seen in Table 1. The maximum limit for lead contamination in fresh milk set by WHO is 0.02 ppm. From this data, it can be said that the fresh milk samples from the two places contain lead with concentrations far exceeding the maximum limit allowed by WHO, in other words, it is harmful to health if consumed both in the short and long term. The high lead content in fresh milk may be due to soil and water being exposed to high lead sources near polluted locations, such as landfills [17], [18].

The presence of high concentrations of lead in milk may also be due to the consumption of feed ingredients and water contaminated by industrial emissions and fertilizers (phosphate rock, which is the basis of commercial fertilizers and sludge), which can contaminate soil and crops that feed cattle. In addition, cows can inhale smoke and dust from industrial activities, and cadmium-coated metal utensils used in commercial food processing, kitchen utensils enamel, and incineration of cadmium-containing plastics [19]. The lead content in the samples from the Lubuk Minturun location is lower than the samples from the Padang Panjang location as shown in Figure 1. This indicates that lead contamination in the dairy farming environment at the Padang Panjang location is higher than in the Lubuk Minturun location.

Zinc (Zn)

Table 1 displays data on zinc content in fresh milk samples from two different locations, namely Lubuk Minturun (28.83±1.81 ppm) and Padang Panjang (53.08±2.40 ppm). The zinc content in samples from Padang Panjang was greater than those from Lubuk Minturun. Even so, both values far exceed the maximum zinc content in fresh milk that has been set by WHO, which is 5 ppm. The presence of zinc in high concentrations is thought to come from the use of livestock equipment used and feed contaminated with heavy metals. Within certain limits, zinc is needed by the body. Zinc is indispensable for the structure and activity of more than 300 enzymes responsible for nucleic acid and protein synthesis, cellular differentiation and replication, insulin secretion, sexual maturation and may also be involved in the functional performance of the immune system and other physiological processes [20]. However, zinc contamination in high concentrations can cause nausea and vomiting in children, anemia, and cholesterol problems in adults [21].

Copper (Cu)

Copper detected in fresh milk samples from the Lubuk Minturun location was 1.17±0.38 ppm. This value is lower than the maximum limit for copper content in fresh milk allowed by WHO, which is 1.3

ppm. Meanwhile, the copper content in the samples from Padang Panjang was 2.17±0.38 ppm exceeds the maximum allowable limit. This higher copper content could be due to contamination from the livestock equipment used. In addition, the feed and water used for dairy cows can also be contaminated with heavy metals from the surrounding environment.

Copper, as an essential trace element, is required for adequate growth, cardiovascular system integrity, lung elasticity, neuron-endocrine function, and iron metabolism [22]. Copper is also recognized as an important redox-active transition metal and an important micronutrient due to its multiple oxidation stages in vivo is involved in many structural and enzymatic activities as it is part of the structure in regulatory proteins and is involved in photosynthetic electron transport, mitochondrial respiration, oxidative stress response, metabolism, cell wall and hormone signaling for plant growth and development when present in optimal concentrations and environmental conditions [23]. The daily intake (mg/day) for copper in milk and dairy products ranged from 0.002 to 0.0191 mg/day. Nevertheless, copper harms the human body in high concentrations. Due to contamination, copper can reach high levels in milk and dairy products [21].

Chromium (Cr)

Chromium levels (ppm) in fresh milk samples from two different farm locations were not detected as shown in Table 1. Chromium contamination usually comes from the use of metal-based livestock equipment. In addition, chromium can also contaminate animal feed from soil and water near factory sites and landfills. From Figure 1, it can be concluded that fresh milk from Lubuk Minturun and Padang Panjang farms does not contain chromium with concentrations that can be harmful to health if consumed. WHO sets the maximum limit for chromium contamination in milk is 0.1 ppm. Chromium is known as an essential element for normal carbohydrate metabolism in animal and human nutrition [24]. However, in excess levels, chromium poisoning can cause skin irritation, accumulate in the liver, and systemic poisoning [25].

Calcium (Ca)

Calcium is responsible for many functions in the body such as heart rhythm, blood clotting, hormone secretion, muscle contraction, activation of enzymes in the body, and is also needed in bone structure. Calcium makes up 1.5-2% of the mass of an adult. Milk and its dairy products are foods rich in calcium, which is one of the most important minerals in fresh milk, and the amount varies according to the region and the breed of the dairy cow [26]. In this study, the average calcium content in the fresh milk from Lubuk Minturun was674.00±2.46 ppm. This value is higher when compared to the calcium content of the samples from Padang Panjang (504.25±2.63 ppm). These two data can be seen in Figure 2. The amount of calcium in the samples from these two different locations was higher than the average calcium content in fresh milk, which was 280 ppm [27]–[29]. Based on the results of this study, it appears that the calcium content in fresh milk samples from two locations (LM and PP) can be a good source of nutrition for humans regardless of heavy metal contamination due to contaminated equipment, feed, and water.

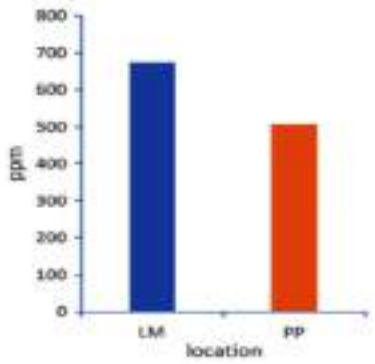

Figure 2. Calcium concentration of fresh milk samples from two different locations (LM and PP).

4. Conclusion

Information on the presence of heavy metals in dairy products from local farms is not available, which is necessary for policymaking, standard formation, and for taking corrective action, if available. This study is needed to evaluate the content of heavy metals and calcium in fresh milk samples from Lubuk Minturun Padang and Padang Panjang locations to confirm the health risks if the milk is consumed. Among all the heavy metals analyzed, cadmium, copper, and chromium contained in fresh milk samples from these two locations were below the maximum limit set by WHO. Meanwhile, the calcium content contained in the fresh milk samples from the two locations was quite high when compared to the average calcium content in fresh milk in general. However, for lead and zinc, the contamination is above the maximum contaminant level (MCL). The lead content in fresh milk samples were 13.58±1.01 ppm (Lubuk Minturun) and 20.58±2.02 ppm (Padang Panjang). And zinc content in fresh milk samples were 28.83±1.81 ppm (Lubuk Minturun) and 53.08±2.40 ppm (Padang Panjang). Therefore, fresh milk from these two locations is dangerous for human consumption. Further studies are needed to determine the exact cause of heavy metal contamination in fresh milk originating from the Lubuk Minturun and Padang Panjang locations so that a good solution can be found so that the fresh milk produced from these two locations is safe for consumption in the future.

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ANALYSIS OF HEAVY METALS (Cd, Pb, Zn, Cu, Cr) AND CALCIUM IN FRESH COW'S MILK ORIGIN PADANG AND PADANG PANJANG

ANALISIS LOGAM BERAT (Cd, Pb, Zn, Cu, Cr) DAN KALSIUM DALAM SUSU SAPI SEGAR ASAL PADANG DAN PADANG PANJANG

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ABSTRACT

Cow's milk is an important intake in a healthy diet because of its high calcium content. However, the contamination contained in milk can be harmful to health. The safety of cow's milk decreases with the increase in the concentration of heavy metals that are toxic to the body. This study aims to investigate the content of heavy metals (Cd, Pb, Zn, Cu, Cr) and Ca mineral contained in fresh cow's milk samples from two different locations, namely the city of Padang and the city of Padang Panjang. The quantitative method used in this research is Atomic Absorption Spectroscopy (AAS). The average heavy metal and Ca minerals contained in fresh milk samples from the Lubuk Minturun area, Padang City were; cadmium (Cd) was not detected, lead (Pb) 13.58±1.01 ppm, zinc (Zn) 28.83±1.81 ppm, copper (Cu) 1.17±0.38 ppm, chromium (Cr) not detected and calcium (Ca) 674.00±2.46 ppm. Meanwhile, for fresh milk samples from the Padang Panjang area; Cd was not detected, Pb 20.58±2.02 ppm, Zn 53.08±2.40 ppm, Cu 2.17±0.38 ppm, Cr was not detected and Ca 504.25±2.63 ppm. All samples from both regions showed heavy metal content of Pb, Zn and Cu which exceeded the maximum limit set by the Environmental Protection Agency (EPA) so that it could cause negative impacts on health when consumed. This is thought to be caused by cattle feed contaminated by garbage and pesticides which requires further research.

Keywords: fresh milk, heavy metals, calcium, AAS

ABSTRAK

Susu sapi adalah asupan penting dalam pola makanan yang sehat karena kandungan kalsiumnya yang tinggi. Akan tetapi, kontaminasi yang terdapat dalam susu bisa membahayakan kesehatan. Keamanan susu sapi menurun seiring dengan peningkatan konsentrasi logam berat yang bersifat toksik bagi tubuh. Penelitian ini bertujuan untuk menyelidiki kandungan logam berat (Cd, Pb, Zn, Cu, Cr) dan mineral Ca yang terkandung dalam sampel susu sapi segar yang berasal dari dua lokasi yang berbeda, yaitu kota Padang dan kota Padang Panjang. Metode kuantitatif yang digunakan dalam penelitian ini adalah metode Spektroskopi Serapan Atom (SSA). Rata-rata logam berat dan mineral Ca yang terkandung dalam sampel susu segar asal daerah Lubuk Minturun Kota Padang adalah; kadmium (Cd) tidak terdeteksi, timbal (Pb) 13,58±1,01 ppm, seng (Zn) 28,83±1,81 ppm, tembaga (Cu) 1,17±0,38 ppm, krom (Cr) tidak terdeteksi dan kalsium (Ca) 674,00±2,46 ppm. Sementara untuk sampel susu segar dari daerah Padang Panjang; Cd tidak terdeteksi, Pb 20,58±2,02 ppm, Zn 53,08±2,40 ppm, Cu 2,17±0,38 ppm, Cr tidak terdeteksi dan Ca 504,25±2,63 ppm. Semua sampel dari kedua daerah memperlihatkan kandungan logam berat Pb, Zn dan Cu yang melebihi batas maksimum yang ditetapkan oleh *Environmental Protection Agency* (EPA) sehingga dapat menyebabkan dampak negatif terhadap kesehatan apabila dikonsumsi. Hal ini diduga disebabkan oleh pakan sapi yang terkontaminasi oleh sampah dan pestisida yang membutuhkan penelitian lebih lanjut.

Kata kunci : susu segar, logam berat, kalsium, SSA

Heavy metals analysis (Cd, Pb, Zn, Cu, Cr) and calcium in Padang and Padang Panjang fresh cow's milk

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Abstract. Cow's milk is important in a healthy food intake because of its high calcium content. However, the contamination in milk can be harmful to health. The acidity of cow's milk decreases with the increase of heavy metals concentration that is poisonous to the body. This research aims to investigate the content of heavy metals (Cd, Pb, Zn, Cu, Cr) and minerals Ca contained in fresh cow's milk samples from two different locations, which are Padang city and Padang Panjang city. The quantitative method used in this research is Atomic Absorption Spectroscopy (SSA). The average heavy metal and Ca minerals contained in samples of fresh milk from the Lubuk Minturun area are: cadmium (Cd) not detected, lead (Pb) 13.58±1.01 ppm, zinc (Zn) 28.83±1.81 ppm, copper (Cu) 1.17±0.38 ppm, chromium (Cr) not detected, and calcium (Ca) 674.00±2.46 ppm. Meanwhile, fresh milk samples from Padang Panjang area: cadmium (Cd) not detected, Pb 20.58±2.02 ppm, Zn 53.08±2.40 ppm, Cu 2.17±0.38 ppm, chromium (Cr) not detected, and Ca 504.25±2.63 ppm. All samples from both regions showed heavy metal content of Pb, Zn, and Cu which exceeded the maximum limit set by the Environmental Protection Agency (EPA), consequently it could cause negative impacts on health when consumed. This is assumed to be caused by cattle food contamination by garbage and pesticides which requires further research.
Keywords: fresh milk, heavy metals, calcium, SSA

1. Introduction

Citizen population growth and improvement in income that is followed by public awareness on the importance of a healthy lifestyle cause an increase in demand for fresh and processed cow's milk. Demand for milk is growing rapidly, this can be seen from Based on data from BPS (Statistics Central Bureau) data in the year 2021, the level of milk consumption per capita of the Indonesian people in 2020 is 16.27 kg/capita/year, it has increased by 0.25 percent from 2019. This makes milk to become an economic commodity that has strategic value.

Milk is considered a complete food because it contains essential nutrients including protein, essential fatty acids, lactose, vitamins, and minerals in balanced proportions [1]. However, milk can also contain chemical hazards and contaminants, which are technological risk factors for dairy products, for the associated commercial image, and most importantly, for consumer health [2]. One group of hazardous chemicals that can contaminate fresh milk are heavy metals.

In the periodic table, elements with a high atomic number and are metallic at room temperature are referred to as heavy metals. These metals have a gravitational force exceeding 5 g/cm3 [3]. Most of the heavy metals are toxic to living things if they accumulate in the body even at low concentrations [4] [5].

Generally, heavy metal contamination is infected from environmental sources such as soil and water or feed consumed by animals. In addition, metals in the composition of machinery and equipment used during milk storage and processing may leach into the product during milking [6]. When heavy metals enter the human body through different sources, it affects the cellular functions leading to metal poisoning. Some are excreted through the liver or kidneys or spleen, but some metals accumulate in some excretory organs and cause organ damage.

Heavy metals also cause food contamination which is one of the main reasons for maintaining food safety concerns. Major food contaminants include pesticides, toxins along heavy metal contamination [7]. Heavy metals can accumulate in appreciable amounts in crops such as rice, grasses, and some types of legumes for animal feed, including dairy cattle [8].

Lead and cadmium residues in milk are of particular concern because they are mostly consumed by infants and children. Food is the main route of lead and cadmium exposure in the general population (representing >90% of total Cd intake in non-smokers), although inhalation can be a major cause in highly contaminated areas [9]. Lead and cadmium are considered potential carcinogens and are etiologically associated with several diseases of the cardiovascular system, kidneys, nervous system, blood, and skeletal system. Heavy metals that enter the body through food, in addition to disrupting the nervous system, paralysis, and premature death, can also reduce children's intelligence levels [10].

Contamination of .copper metal in foods initially occurred due to excessive use of fertilizers and pesticides[8]. The maximum limit for the copper metal in drinking water set by the EPA is 1.3 ppm. However, copper is a constituent that must be present in the human diet and is needed by the body (Acceptance Daily Intake/ADI = 0.05 mg/kg body weight). At this level, there is no accumulation in the normal human body. However, the intake of large amounts in the human body can cause acute symptoms.

Sensitive organs that are the main targets of heavy metals are soft tissues, such as the kidneys, liver, and central nervous system. Accumulation of heavy metals in dairy animals harms health and processed production. Heavy metal contaminants enter animal systems due to pollution of air, water, soil, and consumption of contaminated feed; Improper manufacturing practices and use of contaminated equipment also contribute to milk contamination with heavy metals [4], [11], [12]. Heavy metals that can be transferred from livestock machinery and equipment are Cu, Zn, Cd, and Pb [13].

Because of the rapid developments in industry and agriculture, the assessment of heavy metal contamination in fresh milk and its derivatives has become very important [14]. This also applies in the city of Padang and Padang Panjang. The purpose of this study was to determine the metal content of Lead (Pb), Zinc (Zn), Copper (Cu), Cadmium (Cd), Chrom (Cr), and Calcium (Ca) in pure cow's milk from two different locations.

2. Methodology

2.1. Sample Collection

Samples of fresh cow's milk were obtained from dairy farms located in two different locations, which are: Lubuk Minturun in Padang City and Padang Panjang City to determine the levels of Lead (Pb), Zinc (Zn), Copper (Cu), Cadmium (Cd), Chrom (Cr) and Calcium (Ca) using the Atomic Absorption Spectrophotometry (SSA) method in the Chemistry laboratory of LL Dikti Region X, Padang, West Sumatra.

2.2. Sample Preparation

Fresh milk samples (5 mL or g) were destructed with a mixture of nitric acid and perchloric acid (HNO3: HClO3 = 4:1 v/v) until a transparent solution was obtained. [15]. After digestion, the sample is filtered and diluted to a predetermined concentration. Standard solutions of Pb, Zn, Cu, Cd, Cr, and Ca were prepared by diluting certified standard solutions to the desired concentration. All reagents used are analytical reagent grade. Very high purity water is used for all dilutions. All glass and plastic

items were washed and stored overnight in a 10% (v/v) nitric acid solution. After that, it is rinsed thoroughly with ultrapure water and then is dried.

2.3. Sample Analysis

Standard solutions with concentrations of 10 ppm, 20 ppm, 30 ppm, 40 ppm, and 50 ppm were measured using an Atomic Absorption Spectrophotometer at a wavelength and a cathode lamp according to the metal to be analyzed. The standard curve is made by plotting the absorbance value against the concentration of the solution (ppm). The same treatment was also used in the solution of fresh cow's milk samples.

2.4. Statistic analysis

Concentrations of all metals are reported as mean±SD. Each metal was analyzed at least three times for each sample.

3. Results and Discussion

The concentrations of heavy metals (Cd, Pb, Zn, Cu, Cr) and calcium contained in fresh milk samples from two different farm locations, namely: Lubuk Minturun Padang (LM) and Padang Panjang (PP) are shown in Table 1. Maximum metal limits The weight reference in this article is the Maximum Contaminant Level (MCL) set by the World Health Organization (WHO) in Geneva, Switzerland. The unit used is ppm which is equivalent to mg/Kg.

Table 1. Heavy metal and calcium concentrations of fresh milk samples from two different locations

Metal	LM (ppm)	PP (ppm)	MCL by WHO (ppm)
CD	ND	ND	0.005
Pb	13.58±1.01	20.58±2.02	0.02
Zn	28.83±1.81	53.08±2.40	5
Cu	1.17±0.38	2.17±0.38	1.3
Cr	ND	ND	0.1
Ca	674.00±2.46	504.25±2.63	-

*Mean±SD; *ND:Not Determined, ND means <LOD
*LM: Lubuk Minturun Area *PP: Padang Panjang Area
*MCL:Maximum Contaminant Level

Cadmium (Cd)

Cadmium contamination (ppm) of fresh milk samples from two different farm locations was not detected as can be observed in Table 1. This proves that the soil and water that are the source of dairy cattle feed are not contaminated by cadmium. In addition, the livestock equipment used also does not contain cadmium which can contaminate the fresh milk produced. The maximum limit for cadmium contamination in milk set by WHO is 0.005 ppm. From Figure 1, it can be concluded that fresh milk from Lubuk Minturun and Padang Panjang farms is free from cadmium contamination which can cause poisoning if consumed. Acute symptoms of cadmium poisoning are chest tightness, dry throat and chest tightness, shortness of breath, gasping for breath, distress, and can progress to pneumonia,[8]. Prolonged accumulation of cadmium in excretory organs can cause organ damage and also cause changes in cellular function. Continuous long-term exposure can even cause cancer[16].

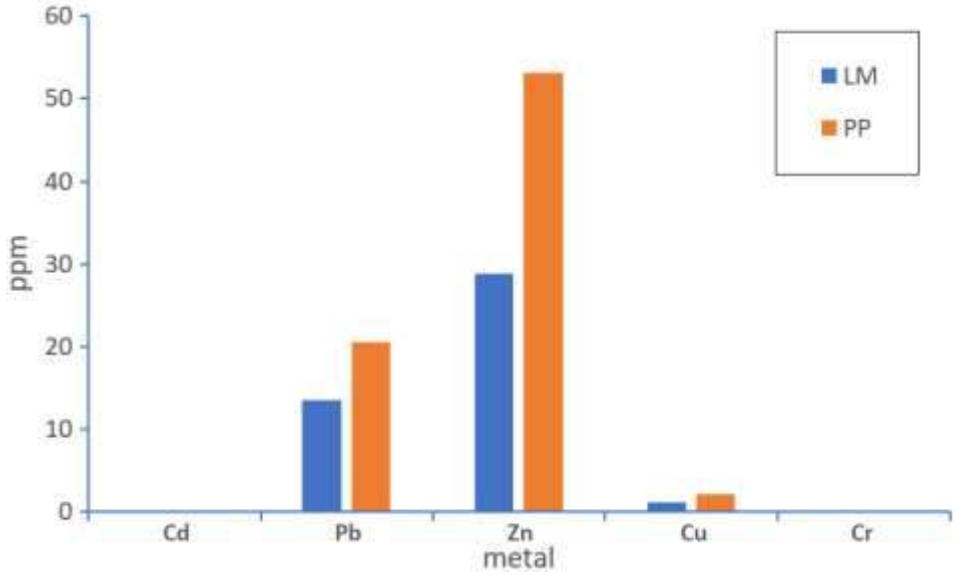

Figure 1. Heavy metal concentrations of fresh milk samples from two different locations (LM and PP).

Lead (Pb)

The lead content in fresh milk samples from Lubuk Minturun (LM) detected was 13.58±1.01 ppm, while the lead contained in the sample from Padang Panjang was 20.58±2.02 ppm as can be seen in Table 1. The maximum limit for lead contamination in fresh milk set by WHO is 0.02 ppm. From this data, it can be said that the fresh milk samples from the two places contain lead with concentrations far exceeding the maximum limit allowed by WHO, in other words, it is harmful to health if consumed both in the short and long term. The high lead content in fresh milk may be due to soil and water being exposed to high lead sources near polluted locations, such as landfills [17], [18].

The presence of high concentrations of lead in milk may also be due to the consumption of feed ingredients and water contaminated by industrial emissions and fertilizers (phosphate rock, which is the basis of commercial fertilizers and sludge), which can contaminate soil and crops that feed cattle. In addition, cows can inhale smoke and dust from industrial activities, and cadmium-coated metal utensils used in commercial food processing, kitchen utensils enamel, and incineration of cadmium-containing plastics.[19]. The lead content in the samples from the Lubuk Minturun location is lower than the samples from the Padang Panjang location as shown in Figure 1. This indicates that lead contamination in the dairy farming environment at the Padang Panjang location is higher than in the Lubuk Minturun location.

Zinc (Zn)

Table 1 displays data on zinc content in fresh milk samples from two different locations, namely Lubuk Minturun (28.83±1.81 ppm) and Padang Panjang (53.08±2.40 ppm). The zinc content in samples from Padang Panjang was greater than those from Lubuk Minturun. Even so, both values far exceed the maximum zinc content in fresh milk that has been set by WHO, which is 5 ppm. The presence of zinc in high concentrations is thought to come from the use of livestock equipment used and feed contaminated with heavy metals. Within certain limits, zinc is needed by the body. Zinc is indispensable for the structure and activity of more than 300 enzymes responsible for nucleic acid and protein synthesis, cellular differentiation and replication, insulin secretion, sexual maturation and may also be involved in the functional performance of the immune system and other physiological processes.[20]. However, zinc contamination in high concentrations can cause nausea and vomiting in children, anemia, and cholesterol problems in adults [21].

Copper (Cu)

Copper detected in fresh milk samples from the Lubuk Minturun location was 1.17±0.38 ppm. This value is lower than the maximum limit for copper content in fresh milk allowed by WHO, which is 1.3 ppm. Meanwhile, the copper content in the samples from Padang Panjang was 2.17±0.38 ppm exceeds the maximum allowable limit. This higher copper content could be due to contamination from the livestock equipment used. In addition, the feed and water used for dairy cows can also be contaminated with heavy metals from the surrounding environment.

Copper, as an essential trace element, is required for adequate growth, cardiovascular system integrity, lung elasticity, neuron-endocrine function, and iron metabolism. [22]. Copper is also recognized as an important redox-active transition metal and an important micronutrient due to its multiple oxidation stages in vivo is involved in many structural and enzymatic activities as it is part of the structure in regulatory proteins and is involved in photosynthetic electron transport, mitochondrial respiration, oxidative stress response, metabolism. cell wall and hormone signaling for plant growth and development when present in optimal concentrations and environmental conditions [23]. The daily intake (mg/day) for copper in milk and dairy products ranged from 0.002 to 0.0191 mg/day. Nevertheless, copper harms the human body in high concentrations. Due to contamination, copper can reach high levels in milk and dairy products [21].

Chromium (Cr)

Chromium levels (ppm) in fresh milk samples from two different farm locations were not detected as shown in Table 1. Chromium contamination usually comes from the use of metal-based livestock equipment. In addition, chromium can also contaminate animal feed from soil and water near factory sites and landfills. From Figure 1, it can be concluded that fresh milk from Lubuk Minturun and Padang Panjang farms does not contain chromium with concentrations that can be harmful to health if consumed. WHO sets the maximum limit for chromium contamination in milk is 0.1 ppm. Chromium is known as an essential element for normal carbohydrate metabolism in animal and human nutrition[24]. However, in excess levels, chromium poisoning can cause skin irritation, accumulate in the liver, and systemic poisoning [25].

Calcium (Ca)

Calcium is responsible for many functions in the body such as heart rhythm, blood clotting, hormone secretion, muscle contraction, activation of enzymes in the body, and is also needed in bone structure. Calcium makes up 1.5-2% of the mass of an adult. Milk and its dairy products are foods rich in calcium, which is one of the most important minerals in fresh milk, and the amount varies according to the region and the breed of the dairy cow.[26]. In this study, the average calcium content in the fresh milk from Lubuk Minturun was674.00±2.46 ppm. This value is higher when compared to the calcium content of the samples from Padang Panjang (504.25±2.63 ppm). These two data can be seen in Figure 2. The amount of calcium in the samples from these two different locations was higher than the average calcium content in fresh milk, which was 280 ppm [?]. Based on the results of this study, it appears that the calcium content in fresh milk samples from two locations (LM and PP) can be a good source of nutrition for humans regardless of heavy metal contamination due to contaminated equipment, feed, and water.

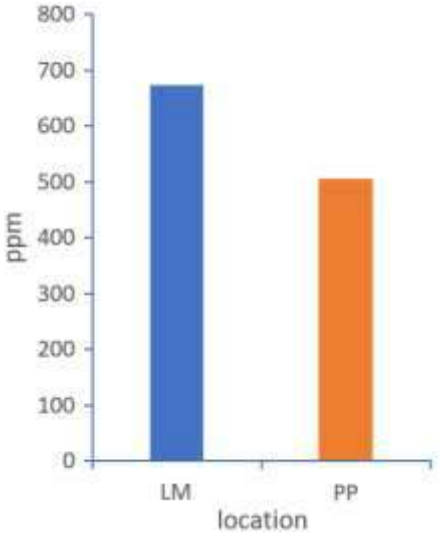

Figure 2. Calcium concentration of fresh milk samples from two different locations (LM and PP).

The lead and cadmium contents in all the samples were lower than that reported in the literature (Tripathi et al. 1999; Licata et al. 2004). The presence of lead in milk and milk products could be due to various factors like transhumance along roads, fodder contamination, climatic factors like winds, and the use of chemical fertilizers. Cadmium concentration in milk and milk products depends largely on the type of food and cadmium load in the food production environment (Olsson et al. 2002). The presence of cadmium in samples could be due to fodder contamination through the soil. Cadmium is also the major impurity present in phosphate fertilizers. A recent study suggested that the main input of cadmium to animal feed in milch animals is feeding crops in heavy metal premixes, fish meal, and minerals like limestone and phosphate (Tu et al. 2007). Arsenic has been the only human carcinogen with registered evidence of carcinogenic risk by both inhalation and ingestion (Bhattacharya et al. 2007) and related with lung, liver, skin, and bladder cancer in human beings (Kapaj et al. 2006). There are limited data on mercury residues in milk in comparison with other heavy metals, especially lead and cadmium.

4. Conclusion

Information on the presence of heavy metals in dairy products from local farms is not available, which is necessary for policymaking, standard formation, and for taking corrective action, if available. This study is needed to evaluate the content of heavy metals and calcium in fresh milk samples from Lubuk Minturun Padang and Padang Panjang locations to confirm the health risks if the milk is consumed. Among all the heavy metals analyzed, cadmium, copper, and chromium contained in fresh milk samples from these two locations were below the maximum limit set by WHO. Meanwhile, the calcium content contained in the fresh milk samples from the two locations was quite high when compared to the average calcium content in fresh milk in general. However, for lead and zinc, the contamination is above the maximum allowable limit. Therefore, fresh milk from these two locations is dangerous for human consumption. Further studies are needed to determine the exact cause of heavy metal contamination in fresh milk originating from the Lubuk Minturun and Padang Panjang locations so that a good solution can be found so that the fresh milk produced from these two locations is safe for consumption in the future.

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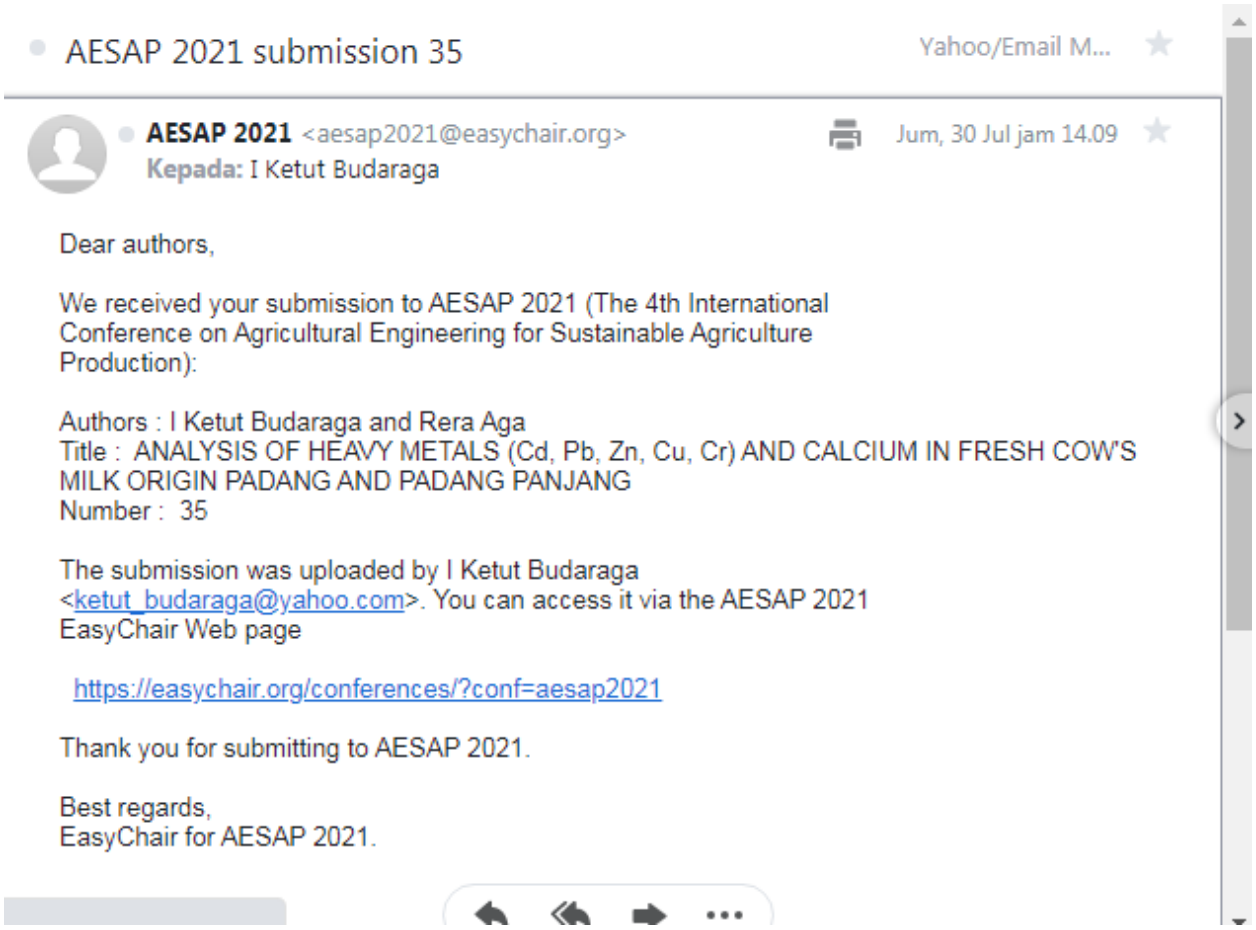
Bukti summit artikel, 30 Juli 2021



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Paper:	(Jul 30, 07:09 GMT)
Author keywords:	fresh milk heavy metals calcium AAS
Abstract:	Cow's milk is an important intake in a healthy diet because of its high calcium content. However, the contamination contained in milk can be harmful to health. The safety of cow's milk decreases with the increase in the concentration of heavy metals that are toxic to the body. This study aims to investigate the content of heavy metals (Cd, Pb, Zn, Cu, Cr) and Ca mineral contained in fresh cow's milk samples from two different locations, namely the city of Padang and the city of Padang Panjang. The quantitative method used in this research is Atomic Absorption Spectroscopy (AAS). The average heavy metal and Ca minerals contained in fresh milk samples from the Lubuk Minturun area, Padang City were: cadmium (Cd) was not detected, lead (Pb) 13.58±1.01 ppm, zinc (Zn) 28.83±1.81 ppm, copper (Cu) 1.17±0.38 ppm, chromium (Cr) not detected and calcium (Ca) 674.00±2.46 ppm. Meanwhile, for fresh milk samples from the Padang Panjang area; Cd was not detected, Pb 20.58±2.02 ppm, Zn 53.06±2.40 ppm, Cu 2.17±0.38 ppm, Cr was not detected and Ca 504.25±2.65 ppm. All samples from both regions showed heavy metal content of Pb, Zn and Cu which exceeded the maximum limit set by the Environmental Protection Agency (EPA) so that it could cause negative impacts on health when consumed. This is thought to be caused by cattle feed contaminated by garbage and pesticides which requires further research.
Submitted:	Jul 30, 07:09 GMT
Last update:	Jul 30, 07:09 GMT

Authors

first name	last name	email	country	affiliation	Web page	corresponding?
I Ketut	Budaraga	ketut_budaraga@yahoo.com	Indonesia	Universitas Ekasakti	http://myiketutbudaraga.blogspot.com/	✓
Rera	Aga	axspartan@gmail.com	Indonesia	universitas ekasakti		

The 4th International Conference on
Agricultural Engineering for Sustainable Agriculture Production
Secretariat: Department of Mechanical and Biosystem Engineering IPB University
Darmaga Bogor PO BOX 220.phone/fax: +62-251-8623026 Bogor Indonesia
email: aesap@apps.ipb.ac.id, https://aesapconference.com/

ACCEPTANCE LETTER

We are pleased to inform you that your paper entitled:

ANALYSIS OF HEAVY METALS (Cd, Pb, Zn, Cu, Cr) AND CALCIUM IN FRESH COW'S MILK ORIGIN PADANG AND PADANG PANJANG

Authored by:
I Ketut Budaraga and Rera Aga

Has been accepted by the Scientific Committee to be presented virtually at the 4th International Conference on Agricultural Engineering for Sustainable Agricultural Production (AESAP 2021) on 11-12 October 2021.

To confirm your presentation, please proceed with this announcement with the transfer payment of your participation not later than 30 September 2021 to:

Bank name	: Bank Negara Indonesia (BNI)
Account holder	: Rektor IPB C/Q KS Fateta PTN
Account number	: 3889948
Branch name	: Bogor, Indonesia

The details of the review process of the full paper for the IOP Publication will be conducted after the conference. Please be notified that only presented and reviewed papers will be eligible for the IOP Publication.
Please refer to the conference website for the registration and all necessary information.

We are looking forward to seeing you at the conference.

Best Regards

Dr. Supriyanto, S.TP, M.Kom
Chairman
+62 812-9603-1300

AESAP 2021 <aesap2021@easychair.org>
Kepada:I Ketut Budaraga
Sel, 17 Agt jam 16.51

Dear Authors AESAP 2021,

We are pleased to notify that your submitted abstract for the the 4th International Conference on Agricultural Engineering for Sustainable Agriculture Production 2021 (AESAP 2021) has been accepted by the Paper Committee of the conference as a relevant one to the theme and topics of the conference. We apologize for the delay in making a decision on your abstract.
The recipient paper is entitled to perform an oral presentation at the conference and could submit a full paper via EasyChair for the peer reviewing process.

The full paper must be matched with the following IOP Conference Series template.
If you have not published a paper in the IOP Conference Series, please find the full paper template from the link below:
https://aesapconference.com/paper-template/

Pleas be notified that the important dates of AESAP 2021 are as follows:
- Deadline for Full Paper: September 12, 2021
- Notification of full paper acceptance: September 19, 2021
- Deadline for registration payment and publication fee: September 26, 2021

Thank you for your contribution to the AESAP 2021.

Best regards,

AESAP 2021 Secretariat

IPB University
Bogor Indonesia

AESAP 2021

PROGRAM BOOK

The 4th International Conference on
Agricultural Engineering for Sustainable Agricultural Production

"The Role of Agricultural and Biosystem Engineering to provide and manage Food, Land, Water, and Bioenergy to achieve Sustainable Development Goals (SDGs) toward Industry 4.0"

Hosted by Department of Mechanical and Biosystem Engineering,
IPB University, 11-12 October 2021

Organized by:
Departemen of Mechanical and Biosystem Engineering, Faculty of Agricultural Technology, IPB University
Indonesian Society of Agricultural Engineers (ISAE), Bogor Chapter.
Indonesian Industrial and Beverage Crops Research Institute, Ministry of Agriculture - Republic of Indonesia
Yanmar Research Institute - IPB University

Departemen

Balittri

YARI IPB

Message from Chairperson of The AESAP 2021

I am delighted and honored to welcome you all to 4th International Conference on Agricultural Engineering for Sustainable Agriculture Production (AESAP) 2021 organized by Mechanical and Biosystem Engineering Department, Faculty of Agriculture Engineering and Technology, IPB University collaborated with (1) Indonesian Society of Agricultural Engineering (ISAE) Bogor Chapter, (2) Indonesian Industrial & Beverages Crops Research Institute (IIBCRI), Ministry of Agriculture, Indonesia, (3) Indonesian Industrial and Beverage Crops Research Institute, Ministry of Agriculture - Republic of Indonesia and (4) Yanmar Agricultural Research Institute (YARI) IPB.

The conference provides an opportunity to strengthen network among academicians, researcher, practitioners and government in collaboration for sustainable agriculture productions. This year, the theme of the conference is "*The Role of Agricultural and Biosystem Engineering to provide and manage Food, Land, Water, and Bioenergy to achieve Sustainable Development Goals (SDGs) toward Industry 4.0".* The conference will thematically discuss the contribution of bio-system engineering for sustainable agriculture in the industrial revolution 4.0 era, covering topics of agricultural engineering field, such as:

1. Postharvest and Food Engineering
2. Energy and Agricultural Machinery
3. Land and Water Resources Engineering
4. Agricultural Structure and Environment Engineering
5. System Engineering and Informatics for Agriculture

Despite of pandemic, prominent keynote speakers, invited speakers, and participants from several countries are enthusiastic to joint this virtual conference and present their research works. We are glad and grateful to have two notable keynote speakers at the conference.

On behalf of the organizing committee, I would like to thank the steering committee, organizing committee, all supporting organizations, all speakers and special thanks also extended to our main sponsor. I hope this conference will succeed with a real contribution to our life.

Bogor, October 2021

Dr. Supriyanto, S.TP, M.Kom

Organizer

The symposium is organized by organized by Mechanical and Biosystem Engineering Department, Faculty of Agriculture Engineering and Technology, IPB University collaborated with (1) Indonesian Society of Agricultural Engineering (ISAE) Bogor Chapter, (2) Indonesian Industrial & Beverages Crops Research Institute (IIBCRI), Ministry of Agriculture, Indonesia, (3) Indonesian Industrial and Beverage Crops Research Institute, Ministry of Agriculture - Republic of Indonesia and (4) Yanmar Agricultural Research Institute (YARI) IPB.

Secretariat Address

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Email : aesapconference@apps.ipb.ac.id

Website: https://www.aesapconference.org

Content

Conference Program

Monday-Tuesday, 11-12 October 2021

First Day	**Monday, 11 October 2021**
08.00-09.00	Registration
09.00-10.00	**Opening Ceremony and Plenary Session** (Venue: Online Meeting)
	Greeting and Opening:
	Report from the Chairperson of Organizing Committee *Dr. Supriyanto*
	Congratulatory Speech from head of Indonesian Industrial & Beverages Crops Research Institut (IIBCRI), Ministry of Agriculture, Indonesia *Dr. Tri Joko Santoso, S.P., M.Si*
	Welcoming address and opening ceremony by IPB University Rector *Prof. Dr. Arif Satria*
10.00-12.30	**Plenary Session I: Agriculture Mechanization in Global Perspective** Moderator: Dr. Ir. Desrial, M.Agr (Indonesian Society of Agriculture Engineering)
10.15-10.20	Opening
10.20-10.45	Dr. Ir. Sam Herodian (Former Senior Advisor Minister of Agriculture, Indonesia – IPB University) *Agriculture Mechanization for Agriculture Production in Indonesia*
10.45-11.10	Prof. Mikio Umeda (Advisor to Yanmar Holdings Co., Ltd) *Present Status of Agriculture Mechanization for Agriculture Production in Japan*
11.10-11.35	Dr. Dares Kittiyopas (President of Thailand Society of Agricultural Engineers) *Agricultural and Bioproduction Machinery in Thailand*
11.35-12.00	Dr. Rossana Marie c. Amongo (Dean of the UPLB College of Engineering and Agro-industrial Technology) *Agricultural and Bioproduction Machinery in Philippine*
12.00-12.30	Discussion
12.30-13.30	Break
13.30-16.30	Paralel Session
	Paralel 1 | Paralel 2 | Paralel 3 | Paralel 4 | Paralel 5

2nd Day	Tuesday, 12 October 2021
	Registration
09.00-11.00 (Jakarta Time)	**Plenary Session II:** **Sustainable and Renewable Energy Prospect** Moderator: Dr. Ir. Edy Hartulistyoso, M.Agr
09.05-09.25	Dr. Ir. Dadan Kusdiana, M.Sc (Director General of New Energy & Renewable Energy and Energy Conservation, Ministry of Energy and Mineral Resources, Indonesia) *Renewable Energy Policy in Indonesia*
09.25-09.45	Assoc. Prof. Dr. Eng. Muhammad Aziz (Associate Professor at The University of Tokyo) *Biomass System and Process Integration Engineering for Bioenergy Generation*
09.45-10.05	Assoc. Prof. Dr. Ryozo Noguchi (Associate Professor at University of Tsukuba) *Microalgae Biomass Prospect for Renewable Energy Generation: Indonesia and Japan*
10.05-10.25	Prof. Dr. Yukihiko Matsumura (Professor at Hiroshima University) *Biomass Gasification in Near- and Supercritical Water*
10.25.10.55	Discussion
	Break
10.55-11.00	**Plenary Session III. Precision and SMART Agriculture** Moderator: *Dr. Slamet Widodo*
11.00-11-20	Prof. Dr. Kudang Boro Seminar, M.Sc (Professor at IPB University) *PreciPalm: Precision Palm Oil Using Remote Sensing Technology for Fertilizer.*
11.20-11.40	Asif Aunillah, STP., M.Sc (Indonesian Industrial & Beverages Crops Research Institut (IIBCRI), Ministry of Agriculture, Indonesia) *Biofuel Production (from Land to Biofuel production)*
11.40-12.00	Prof. Dr. Ir. Herry Suhardiyanto, M.Sc (Professor at IPB University) *Greenhouse and Plant Factory Prospect in Indonesia*
12.00-12.20	Dr. Arora Amarpreet Singh (Sherpa Space Inc, Korea) *SMART Production in Plant Factory in Industrial Scale*
12.20-12.50	Discussion
12.50-13.30	Break
13.30-16.00	Paralel 1 | Paralel 2 | Paralel 3 | Paralel 4 | Paralel 5
16.00-16.30	Dean faculty of Agriculture Engineering and Technology, IPB University

Parallel Session

Monday, 11 October 2021

Time	Parallel 1: Agriculture Machinery and Automation	
	Author(s)	**Paper**
	SESSION 1	
	ROOM A	
13.30 - 13.45	Reynold Caoili, Delfin Suministrado, Rossana Marie Amongo, Arsenio Resurreccion and Engelbert Peralta	Optimization of Performance of a Sweet Sorghum Peg-tooth Type Threshing Cylinder
13.45 - 14.00	Desrial Desrial and Kurniawan Muhammad	Design and Simulation of Oil Palm FFB Loading Machine
14.00 - 14.15	Haris Pratomo and Annisa Nur Ichniarsyah	READY-TO-PACKAGE OUTPUT DEEP FRY MACHINE DESIGN
14.15 - 14.30	Setya Permana Sutisna, I Dewa Made Subrata, Radite Praeko Agus Setiawan and Tineke Mandang	Development of the turn algorithm of an autonomous combine harvester at the corner of paddy fields
14.30 - 14.45	Astrit Novita Dewanti.and Tineke Mandang.	Analysis of Soil Puddling Method and Its Effect to Physical Properties of Soil
14.45-15.00	**Break**	
	Parallel 1: Agriculture Machinery and Automation	
	Author(s)	**Paper**
15.00 - 15.15	Zhafran Ady Nugroho. Tineke Mandang.	Detemine Field and Machine Operating Condition of Rice Combine Harvester to Minimize Grain Loss
15.15- 15.30	Ad Din Alfarisi, Tineke Mandang and Agus Sutejo	Characteristics of Oil Palm Stem Mulch as Soil Conditioner at Oil Palm Replanting Area
15.30 - 15.45	Zunaidi Ibrahim, Md Asri Mohammad, Mohammad Ali, Zuradzman Mohamad Razlan, Seri Rahayu Ya'Akub	Analysis on the Effect of Metal Inert Gas Welding Current and Travel Speed on the Mechanical Properties of Mild Steel Weld Joints
15.45 - 16.00	Zunaidi Ibrahim, Md Asri Mohammad, Mohammad Razi Asyzowan, Seri Rahayu, Ya'Akub, Muhammad Rusyaidi	Experimental and Analyzing the Effect of Machining Parameters to the Surface Roughness of Aluminium
16.00 - 16.15	A Lubis, T Mandang, W Hermawan, and Sutrisno	Characterization of The Yield and Quality of Patchouli Oil Based on The Size of Chopping and Drying Type

Monday, 11 October 2021

Time	Parallel 2: Machinery and Design	
	Author(s)	**Paper**
	SESSION 1	
	ROOM B	
13.30 - 13.45	Mareli Telaumbanua, Witaningsih Witaningsih, Agus Haryanto, Budianto Lanya, Siti Suharyatun and Febryan Kusuma Wisnu	Performance Comparison of the Implementations of Single Row Power Weeder (Single Engine) and Multi-Row Power Weeder (Twin-Engine) in Rice Fields
13.45 - 14.00	Sri Endah Agustina	Design Development of Portable (Mini) Multifunction Incinerator as Continues Burner for Medical Waste Handling.
14.00 - 14.15	Dyah Wulandani and Zaky Ahmad Ibrahim	Design and performance test of biodiesel reactor model using helical screw agitator and baffles
14.15 - 14.30	Lenny Saulia, I Dewa Made Subrata and Maulana Malik Yusuf	Postural analysis in design evaluation of oil palm loose fruits collector machine
14.30 - 14.45	Cholilur Rohman and Sam Herodian	Analysis of Farm Machinery Requirements Based on Human Labor Productivity in Rice Cultivation - A case study in Sumenep District

14.45-15.00

	Parallel 2: Post Harvest Technology	
	Author(s)	**Paper**
15.00 - 15.15	Adian Rindang, Sutrisno Mardjan, Emmy Darmawati and Edy Hartulistiyoso	Numerical Methods and Its Application in Freezing Process
15.15- 15.30	La Choviya Hawa, Fendi Galih Septiyanto, Yovita Tihardo, Rini Yulianingsih, Bambang Susilo, Anang Lastriyanto and Sumardi Hadi Sumarlan	Drying Kinetics of Porang (Amorphophallus mueller B.) Chips under Open Sun Drying
15.30 - 15.45	Lilik Pujantoro, Harianto Harianto and Waqif Agusta	Quality Development Study of Pineapple (Ananas comosus L. Merr) during Controlled Atmosphere Storage in Low Temperature
15.45 - 16.00	Emmy Darmawati and Mala Ekawati	Coating Application to Extend the Shelf Life of Sweet Potatoes cv. Cilembu

Monday, 11 October 2021

Time	Parallel 3: Post Harvest Technology	
	Paper	**Author(s)**
	SESSION 1	
	ROOM C	
	Author(s)	**Paper**
13.30 - 13.45	Samsudin Samsudin, Tajul Iflah, Syafaruddin Syafaruddin and Yulius Ferry	Yield Qualities Evaluation for Gayo Arabika Coffee Germplasm
13.45 - 14.00	Courage Krah, Sutrisno Sutrisno and Dudi Krisnadi	Effect of Harvest and Postharvest Handling on Quality of Moringa Leaf Powder
14.00 - 14.15	Yusi Dwi Setyoningtyas, Emmy Darmawati and Sutrisno	Optimized Utilization of Post-Harvest Coffee Agricultural Equipment and Machines
14.15 - 14.30	Laras Putri Wigati, Ata Aditya Wardana, Fumihiko Tanaka and Fumina Tanaka	Characterization of Edible Film based on Yam Bean Starch, Calcium Propionate and Agarwood Bouya Essential Oil
14.30 - 14.45	I Ketut Budaraga and Rera Aga	ANALYSIS OF HEAVY METALS (Cd, Pb, Zn, Cu, Cr) AND CALCIUM IN FRESH COW'S MILK ORIGIN PADANG AND PADANG PANJANG

14.45-15.00

	Parallel 3: Post Harvest Technology	
	Author(s)	**Paper**
15.00 - 15.15	Nendyo Adhi Wibowo	The Quality of Arabica Coffee Beans Evaluation in Luwu Regency South Sulawesi, Indonesia
15.15- 15.30	Haisen Hower, Tamrin Tamrin, Filli Pratama and Hersyamsi Hersyamsi	Study on pigment coaction of nipa palm (N. fruticans Wurmb) and peruvian primrose (Ludwigia peruviana (L.) Hara) to improve the efficiency of dye sensitized solar cells (DSSC)
15.30 - 15.45	Usman Ahmad, Slamet Dwi Ratnanto and Evi Savitri Iriani	Food Safety Aspect in the Use of Hydrogen Peroxide in the Cleaning Process of Coriander Seeds
15.45 - 16.00	Waqif Agusta, Dian Anggraeni, Herdiarti Destika Hermansyah and Amanda Dwi Gebrina	Application of Palm Stearin Edible Coating on Cavendish Banana (Musa acuminata)

Monday, 11 October 2021

Time	Parallel 4: Sustainable Agriculture	
	Paper	**Author(s)**
	SESSION 1	
	ROOM D	
	Author(s)	**Paper**
13.30 - 13.45	Samuel Keegen Bangun, Arifin Dwi Saputro, Mira Aprillia Nur Fadilah, Sri Rahayoe, Yudha Dwi Prasetyatama and Arima Diah Setiowati	Preliminary study: the addition of konjac glucomannan-based hydrogel into chocolate increases the melting point of chocolate
13.45 - 14.00	Laili Nur Azizah, Mashuri Mashuri and Zainal Abidin	STUDY OF THE USE OF BINAHONG HERBAL DRINK AS COMPLEMENTARY THERAPY TREATMENT WOUNDS IN THE TENGGER TRIBE
14.00 - 14.15	Pichet Pumkaesorn and Naraphorn Paoprasert	Exploring the effect of different number of periods used in various forecasting models for the amount of natural rubber in Thailand
14.15 - 14.30	Bariot Hafif	Comparison of decomposition and adaptation capability of indigenous peat cellulolytic microorganisms
14.30 - 14.45	Bayu Dwi Apri Nugroho, Chusnul Arif, Badi'Atun Nihayah, Umi Hapsari and Fadila Suryandika	Plant Distance Effect on Rice Cultivation System of Rice Intensification (SRI) Method on Tillers and Yield Numbers in East Sumba Regency

14.45-15.00

	Parallel 4: Sustainable Agriculture	
	Author(s)	**Paper**
15.00 - 15.15	Bayu Dwi Apri Nugroho, Chusnul Arif, Umi Hapsari and Fadila Suryandika	The Effect of Plant Densities in System of Rice Itensification (SRI) Method to Water Requirement of Paddy Field in East Sumba, East Nusa Tenggara
15.15- 15.30	Camille Martinez, Chen Wu, Arthur Fajardo and Victor Ella	Hydraulic Performance Evaluation of Locally-Available Low-Cost Gravity-fed Irrigation Systems Under Constant Head Conditions
15.30 - 15.45	Muhammad Nur Salim, Marheni Sembiring and Darma Bakti	Predation Behavior of Myopopone castaneae SMITH Ants Againts Some Insect Larvae in The Laboratory
15.45 - 16.00	Kiman Siregar, Supriyanto Supriyanto, Dwi Susanto, Arief Ar Setiawan, Intan Sofiah and Sholihati Sholihati	Development Software to Evaluate Environmental Impact for Palm Oil (Elaeis guineensis Jacq) Industry using Life Cycle Assessment Approach in Indonesia

Monday, 11 October 2021

Time	Parallel 5: Agricultural Production	
	SESSION 1	
	ROOM E	
	Author(s)	**Paper**
13.30 - 13.45	Kurnia Sasmita, Dewi Nur Rokhmah, Sakiroh Sakiroh, Bariot Hafif and Sunjaya Putra	The Effectiveness of Liquid Organic Fertilizer from Waste Bioconversion on The Growth of Cocoa Seedlings
13.45 - 14.00	Dewi Nur Rokhmah, Dwi Astutik, Handi Supriadi	Cultivation Technology to Mitigate Drought Stress in Tea Plants
14.00 - 14.15	Lilik Pujantoro and Sukamto Sukamto	Development of Materials for Vegetable Pesticides on Tropical Plants for Sustainable Agriculture, First Step Research: Identify the Active Ingredients of Several Essential Oils and the Effectiveness of Pesticides on Plants
14.15 - 14.30	Imanuel Lamma Wabang, Paulus Plaimo and Andri Hendrizal	IN THE ALOR DISTRICT, EAST NUSA TENGGARA PROVINCE, A STUDY OF MAPPING THE POTENTIAL OF SEAWEED MARKET AND MARKET CHAIN
14.30 - 14.45	Lilis Sucahyo, Mohamad Solahudin and Shandra Amarillis	Design and Performance Test of Low Cost Aerophonic Chamber (LCAC) using Ultrasonic Atomizer for Shallot Seedling from True Shallot Seed (TSS)

14.45-15.00

	Parallel 5: Sustainable Agriculture	
	Author(s)	**Paper**
15.00 - 15.15	Supriyanto Supriyanto and Dea Aprilia	Life cycle cost analysis of Local Rice Production Scenarios for Bangka Regency, Indonesia
15.15- 15.30	Mohamad Solahudin, Lilis Sucahyo and Sandra Amarilis	Techno Economic Analysis of Shallot Planting Material Production From TSS (True Shallot Seed) with LCAC (Low Cost Aerophonic Chamber) Technology
15.30 - 15.45	Nova Anika, Dhiya Asti Ramadhani and Lukman Wijaya	The Water, Food, and Energy Nexus in Lampung Province, Indonesia
15.45 - 16.00	Nova Anika, Intan Nur Azizah, Melbi Mahardika, Jabosar R.H Panjaitan and Feerzet Achmad	Effect of Production Technique on Corncob Biochar Quality

Tuesday, 12 October 2021

Time	Parallel 1: Bioenergy	
	Paper	**Author(s)**
	SESSION 1	
	ROOM A	
	Author(s)	**Paper**
13.00 - 13.15	Nur Kholis Firdaus, Asif Aunillah, Edi Wardiana, Dibyo Pranowo, Maman Herman and Syafaruddin Syafaruddin	Comparison of engine performance and emissions for fuels of diesel-biodiesel blends and pure biodiesel
13.15 - 13.30	Herry Irawansyah, Apip Amrullah and Jayadi Fitrah	The effect of temperature distillation on products distribution derived from wood pyrolysis bio-oil
13.30 - 13.45	Delicia Yunita Rahman, Noor Hidhayati, Marsiti Apriastini and Taufik Taufikurrahman	Utilization of anaerobically digested dairy manure wastewater for spirulina maxima cultivation
13.45 - 14.00	Edy Hartulistiyoso, Obie Farobie and Muhadzdzib Zaky	Delignification of Cassava Peel as Bioethanol Raw Material using Combined Alkali and Microwave Heating Methods
14.00 - 14.15	Obie Farobie, Yukihiko Matsumura, Edy Hartulistiyoso, Navid Moheimani, Apip Amrullah, Novi Syaftika and Asep Bayu	The Potential of Sustainable Biogas Production from Macroalgae in Indonesia

14.15-14.30 BREAK

	Parallel 1: Cultivation Technology and Bioenergy	
	Author(s)	**Paper**
14.30 - 14.45	Dewi Rokhmah, Dwi Astutik and Handi Supriadi	Cultivation Technology for Drought Stress Mitigation in Tea Plants
14.45- 15.00	Samsudin Samsudin, Tajul Iflah, Syafaruddin Syafaruddin and Yulius Ferry	Yield Qualities Evaluation for Gayo Arabica Coffee Germplasm
15.00 - 15.15	I Wayan Astika and Fitrian Frenky Hartono	Hydropic Rice Nursery for Rice Transplating Using Rice Transplanters
15.15 - 15.30	Faiz Harisa Ihsan, Maulin Salwa Atikasari, Nadya Fazira Islah Mahdania, Hanifa Farafisha, Muhammad Mu'Tashim Billah and Lilis Sucahyo	DESIGN AND PERFORMANCE ANALYSIS OF CRUDE BIODIESEL REACTOR AND HIGH PRESSURE STOVE USING RECYCLING PALM OIL FOR SMALL AND MEDIUM ENTERPRISE IN BOGOR, INDONESIA.
15.15 - 15.45	Apip Amrullah and Eko Tegus S	Coconut shell bio-oil distillation: Its characteristic and product distribution

Tuesday, 12 October 2021

Time	Parallel 2: Precision Agriculture Technology	
	Paper	**Author(s)**
	SESSION 1	
	ROOM B	
	Author(s)	**Paper**
13.00 - 13.15	M. Azhar Mustafid, I Dewa Made Subrata, Gatot Pramuhadi and Idham Sakti Harahap	Design and Performance Test of Autonomous Precision Spraying Robot for Cabbage Cultivation
13.15 - 13.30	Nova Anika, Lukman Wijaya and Dhiya Asti Ramadhani	Assessment of Water Availability for Rice Cultivation in South Lampung Regency
13.30 - 13.45	Putri Tunjung Sari, Bowo Eko Cahyono, Indarto Indarto and Marga Mandala	Preliminary Assessment of Land Quality Index of the paddy field around Jember Regency
13.45 - 14.00	Nandya Pradita Savitrie and Liyantono	Oil Palm Productivity Estimation Based on Landsat 8 Vegetation Index, Rainfall, and Fertilization Dosage at PT PSJ, South Sumatera
14.00 - 14.15	Radite Praeko Agus Setiawan, Desrial Desrial, Mohamad Solahudin, I Wayan Astika, Slamet Widodo and Dhias Danindra	Veris 3100 application for determining the fertility of rice fields before land preparation
14.15-14.30	**Break**	
	Parallel 2: IoT Agriculture System and Informatics	
	Author(s)	**Paper**
14.30 - 14.45	Muhammad Husein Abdul Halim, Dewa Made Subrata, Slamet Widodo and Mohamad Solahudin	Development of Deep Learning Models on the Navigation System for Assistant Harvesting Robot
14.45- 15.00	Folkes E. Laumal, Herry Suhardiyanto, Mohamad Solahudin and Slamet Widodo	LoRa-based microclimatic parameter monitoring system for smart greenhouses
15.00 - 15.15	Faqih Hamami and Iqbal Ahmad Dahlan	Classification of Tomato Disease Type using Convolution Neural Network
15.15 - 15.30	Muhammad Rusyaidi, Sardar Jaf, , Zunaidi Ibrahim	Machine Learning Method in Detecting a distributed of service (DDoS): A Systematic Literature Review
15.15 - 15.45	Erniati, Herry Suhardiyanto, Rokhani Hasbullah and Supriyanto	Artificial Neural Network Model to Estimate Growth of Melon (Cucumis melo L.) during Vegetative Stage in Greenhouse with Evaporative Cooling

Tuesday, 12 October 2021

Time	Parallel 3: Sensing Technology for Food and Agriculture	
	Author(s)	**Paper**
	SESSION 1	
	ROOM C	
13.00 - 13.15	Diding Suhandy, Kusumiyati Kusumiyati and Meinilwita Yulia	Discrimination Between Arabica and Robusta Coffees Using NIR-Integrating Sphere Spectroscopy Coupled with Hierarchical Clustering Analysis
13.15 - 13.30	Meinilwita Yulia and Diding Suhandy	UV Spectral Analysis Coupled with PCA-LDA to Authenticate Organic and Conventional Lampung Robusta Coffee
13.30 - 13.45	Devi Alicia, M. Fahri Reza Pahlawan and Rudiati Evi Masithoh	Vis/NIR spectroscopy for non-destructive method in detecting soybean viability
13.45 - 14.00	Minarni Shiddiq, Herman, Mhd Feri Desfri, Dewi Laila Sari, Dewi Anjarwati Mahmudah, Irfan Cahyadi and Ihsan Okta Harmailil	Detection and Classification of Basal Stem Rot Disease on Oil Palm Seedlings using Electronic Nose
14.00 - 14.15	Muhammad Daffa Nugraha, Sutrisno Mardjan, Eko Heri Purwanto and Samsudin Samsudin	Prediction of Cocoa Fermentation Level Non-Descriptive with Near Infra Red Spectroscopy
14.15-14.30		
	Parallel 3: Sensing Technology for Food and Agriculture	
	Author(s)	**Paper**
14.30 - 14.45	I Wayan Budiastra and Hendriani Wijayanti	DETECTION OF MECHANICAL DAMAGE IN AVOCADO FRUIT USING ULTRASONIC METHOD
14.45- 15.00	I Wayan Budiastra and M. R. Syafaati Dzikri	EFFECT OF CHEMOMETRICS TO ACCURACY OF NIR SPECTROSCOPY IN PREDICTING TOTAL SOLUBLE SOLID AND HARDNESS OF DRAGON FRUIT
15.00 - 15.15	Usman Ahmad, Muadz A. Rosyid and Mardison Suhil	Abnormal Shapes Identification of Mango Gedong Using Non-dimensional Shape Factors in Image Processing
15.15 - 15.30	Muhammad Fadly Bayu and Setyo Pertiwi	Estimating the ripeness level of avocado (Persea americana) by using ultraviolet reflection

Tuesday, 12 October 2021

Time	Parallel 4: IoT and Automations for Agriculture Production	
	Author(s)	**Paper**
	SESSION 1	
	ROOM D	
13.00 - 13.15	Muhammad Ramaldy Irwin and Prastowo	Design of automatic control system on trickle irrigation for tomato cultivation
13.15 - 13.30	Nikki Alaine Panaligan, Marielle Aringo and Victor Ella	Assessment of potential for adoption of wireless sensor network technology for irrigation water management of high value crops in the Philippines
13.30 - 13.45	Marielle Aringo, Camille Martinez, Orlando Martinez, Ruzell Ramirez, Edzel Agulto and Victor Ella	Development of low-cost soil moisture monitoring system for efficient irrigation water management of upland crops
13.45 - 14.00	Edzel Agulto and Victor Ella	Development of mobile application for wireless sensor networks for efficient irrigation water management
14.00 - 14.15	Ziran Zhang, Steven Glaser, Victor Ella, Ruzell Ramirez, Edzel Agulto and Joseph Hermocilla	Development of a real-time wireless sensor network-based information system for efficient irrigation of upland and lowland crop production systems
14.15-14.30	**Break**	
	Parallel 4: Sustainable Agriculture	
	Author(s)	**Paper**
14.30 - 14.45	Gamiello Pereira, Ruzell Ramirez, Edzel Agulto and Victor Ella	Performance Evaluation of a Wireless Water Level Sensor Under Various Turbidity Levels in Lowland Crop Production Systems
14.45- 15.00	Audry Llaban and Victor Ella	Conventional and sensor-based streamflow data acquisition systems for sustainable water resources management and agricultural applications: An extensive review of literature
15.00 - 15.15	Jia En Chong	Performance of structure-from-motion approach on plant phenotyping using images from smartphone
15.15 - 15.30	Zunaidi Ibrahim, Md Asri Mohammad, Zuradzman Mohamad Razlan, Shahriman Abu Bakar, Seri Rahayu Ya'Akub	An Automated Gantry-Robot Painting System Design and Development Process

Tuesday, 12 October 2021

Time	Parallel 5: GIS and Remote Sensing	
	Author(s)	**Paper**
	SESSION 1	
	ROOM E	
13.00 - 13.15	Chairiyah Umi Rahayu, Siswoyo Soekarno and Indarto Indarto	Using sentinel and comparing two classificationalgorithms for land cover mapping in the area dominated by small scale heterogeneous agricultural land
13.15 - 13.30	Mahrus Irsyam, Indarto Indarto, Bayu Taruna Wijaya Putra and Achmad Subagio	Land cover and vegetation mapping of tropical forest areas in Central Borneo using high-resolution imagery: comparison of classification Algorithms
13.30 - 13.45	Wan Nor Zanariah Zainol Abdullah, Siti Zul Lailee Kamsan and Nik Norasma Che Ya	Mapping and Assessing Black Pepper Growth using Time Series Analysis and Ground Data
13.45 - 14.00	Anggit Novian Berlianto and Putri Indah Sari	IDENTIFICATION OF URBAN SPRAWL PHENOMENON AND ITS IMPLICATIONS IN THE CITY OF YOGYAKARTA PROVINCE OF SPECIAL REGION OF YOGYAKARTA
14.15-14.30	**Break**	
	Parallel 5: GIS and Remote Sensing	
	Author(s)	**Paper**
14.30 - 14.45	Aditya Dwiputra, Kudang Boro Seminar and Sudradjat Sudradjat	ESTIMATION OF POTASSIUM NUTRIENT CONTENT IN TEA PLANTS USING SENTINEL-2 SATELLITE IMAGERY
14.45- 15.00	Riki Renaldi Herdiansyah, Kudang Boro Seminar and Sudradjat Sudradjat	Nitrogen Content Detection in Tea Plants using Satellite Image Processing
15.00 - 15.15	Dhias Danindra, Radite Praeko Agus Setiawan, Desrial, Mohamad Solahudin, I Wayan Astika and Slamet Widodo	Mapping of Soil EC in Relation with Selected Chemical Properties of Soil
15.15-15.30	Nur Adibah Mohidem, Suhaimi Jaafar, Rhushalshafira Rosle, Nik Norasma Che'ya, Jasmin Arif Shah, Wan Fazilah Fazlil Ilahi, Wan Nor Zanariah Zainol, Zulkarami Berahim, Mohamad Husni Omar and Mohd Razi Ismail	Application of multispectral UAV for paddy growth monitoring in Jitra, Kedah, Malaysia

Abstract of Scientific Paper

P-001. Identification of urban sprawl phenomenon and its implications in the city of Yogyakarta Province of Special Region of Yogyakarta

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Abstract. Urban sprawl is a random urban expansion that causes productive land to decrease, change the shape of the city, or irregular morphology of the city. The paper aims to identify the phenomenon of urban sprawl and its implications that occur in the city of Yogyakarta. The methods used are descriptive analysis and spatial analysis through secondary data. The results of this paper include the symptoms or characteristics of urban sprawl found in the city of Yogyakarta, from 14 subdistricts there are 3 subdistricts that have a high potential urban sprawl namely Wirobrajan, Mantrijeron and Kotagede subdistricts. Furthermore, the implications that occur cause some urban problems such as narrowing of land, high population pressure, changeof land use from agricultural land to residential land and shops, land support capacity and declining availability, increased population migration, increased urbanization rate, soaring landinvention prices, development projects that are increasingly spreading and developing economic and industrial centers.

P-002. Comparison of decomposition and adaptation capability ofindigenous peat cellulolytic microorganisms

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Abstract. Cellulolytic microorganisms play an essential role in the weathering of lignocellulosic materials. We studied the potential of indigenous peat cellulolytic microorganisms to decompose peat and adapt to life outside the peat ecosystem. In a greenhouse (GH), we tested indigenous peat cellulolytic microbes such as bacteria of *Comamonas testosteroni* and *Delftia lacustris* and fungi of *Penicillium singorense, Aspergillus aculeatus,* and *Trichoderma* sp to decompose peat. Each cellulolytic bacteria and fungi colony were inoculated to the peat planted by Liberika coffee seedlings and peat without inoculation as control. We also studied their growth in media such as biochar and zeolite mixed with processed coffee and cacao residue in Lab. The cellulolytic fungi were a little stronger than cellulolytic bacteria in peat decomposition. The fungi reduced the organic C of peat by 13.9%, while the bacteria were only 6.4%. The CO_2 flux from peat inoculated by fungi colony, 0.68 mg CO_2/kg peat, and by bacteria colony, 0.64 mg CO_2/kg peat. Both microbes adapted to the environment outside of peat, especially charcoal and zeolite mixed with coffee and cacao residue. However, cellulolytic bacteria were more robust than cellulolytic fungi ifliving simultaneously in the same media.

Keywords: cellulolytic microorganism, peat, CO_2 flux

P-003. Coconut shell bio-oil distillation: Its characteristic and product distribution

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Abstract. The properties of bio-oil distillation and product distribution are critical for parameter optimization and reaction conditions. In this study, low-temperature distillation (96, 97, 98, 99, and 100 °C) was conducted. The slow pyrolysis process at 500 °C with a 1 hour holding period yielded the coconut shell bio-oil employed in this research. Using gas chromatography-mass spectroscopy (GC-MS), the characteristic components in bio-oil were carefully measured. The findings demonstrated that a similar critical point was extensively established during the distillation process, which might be attributed to a stable system created by hydroxyl group. Asa result, bio-oil distillation might be divided into the following stages: steady, explosive, and heating. The content of acetic acid, 2-Furancarboxaldehyde, and phenol are dominated. Acetic acid yield showed an increase, followed by the distillation reaction temperature. Phenol yield was also observed as a dominant product in the bio-oil. The maximum phenol yield was observed at a temperature of 98 ºC (38%). The observed phenomena could be related to the oxidation of hemicellulose, cellulose, and lignin to form phenol, the bio-major oil component. The specific distillation properties and product distribution provide a great look at the reaction process and component enrichment patterns, which can aid formulation and parameter adjustment.

Keywords: Bio-oil, coconut shell, distillation, product distribution

P-006. Plant Distance Effect on Rice Cultivation System of Rice Intensification (SRI) Method on Tillers and Yield Numbers inEast Sumba Regency

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Abstract. SRI is known as a set of methods to increase the productivity of paddy fields by changing the management of yields, soil, and fertilizers/nutrients. The main components of using the SRI method include: transferring young seedlings, planting one seed per hole, wide spacing, keeping the soil moist and not stagnant, controlling weeds by manual weeding, and adding soil organic matter. The study aims to determine the number of SRI rice tillers based ondifferent spacing treatments and their effect on yield productivity. The results of the two treatments of plant spacing, namely 30 x 30 cm (A) and 20 x 10 cm (B) based on statistical tests using the T-Test, showed no significant difference between the two treatments on the number of tillers produced. While the yield showed that treatment A produced 4.27 tons/ha andtreatment B was 4.7 tons/ha, so it concludes that spacing (A) had higher crops than spacing(B).

P-007. The Effect of Plant Densities in System of Rice Intensification(SRI) Method to Water Productivity of Paddy Field in East Sumba, East Nusa Tenggara

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Abstract. Principle of System of Rice Intensification (SRI) adapted to local conditions to increase productivity and environmentally friendly. The main component of SRI is single seedling per hill, young seedlings, wider spacing, intermittent irrigation, inter-cultivation, and organic fertilization. This study area of the System of Rice Intensification is in East Sumba Regency, East Nusa Tenggara, which has typical areas like soil texture, bulk density, soil watercontent, and rainfall. The research aimed to know the effect of plant densities in the System of Rice Intensification (SRI) method on the water productivity of paddy fields. This research initially focused on transplanting very young rice seedlings of 14 days old in two treatments ofplants. The densities are broad in a square pattern (30 x 30 cm) and a Jajar Legowo pattern (20 x 10 x 40 cm). The rice was not grown in flooded paddies but moist ground, with intermittent irrigation. When SRI was concerned at a different wider spacing, it discovered the effect on water productivity for paddy fields, especially in East Sumba, East Nusa Tenggara. So that it determined the best wider spacing of the System of Rice Intensification method can apply in thearea. The results show that the Jajar Legowo pattern spacing (20 x 10 x 40 cm) has a higher water productivity value of 3,4% than the spacing treatment (30 x 30 cm). Jajar Legowo was 11.9% higher than the spacing treatment (30 x 30 cm).

P-008. Oil Palm Productivity Estimation Based on Landsat 8 Vegetation Index, Rainfall, and Fertilization Dosage at PTPSJ, South Sumatera

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Abstract. Estimating oil palm production is one of the essential factors in palm oil management planning which is still done conventionally. This process uses more workers to take data samples from the fields that need more energy and time to get the data. Meanwhile, the yield estimating process could be done using a remote sensing method to save more energy and time on its implementation. This research was conducted to determine the estimation model of oil palm productivity using parameters from the remote sensing method and the company's data, and determine the relationship between current productivity and the previous data. The parameters used to estimate palm oil productivity are NDVI from Landsat 8, rainfall, rainy days, fertilization dosage, and age of the palm oil tree from the company's data. These parameters were shifted several other months back (M-1, M-2, M-3, M-6, and M-12) and grouped into 6-Months and 12-Months to estimate the palm oil production. The result shows that using the previous data can estimate oil palm productivity. The data that can be considered to estimate palm oil production is 12 months (M-12) shifted back. Also, using 3 parameters (NDVI value, rainfall, and fertilization dosage) is enough to estimate palm oil production.

Keyword: palm oil, yield estimation, remote sensing

P-009. Effect of Harvest and Postharvest Handling on Quality ofMoringa Leaf Powder

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Abstract. Moringa Oleifera is a highly nutritious plant with a plethora of uses in various fieldsof life. It serves as food for humans and animals, soil amendment, water purification, skincare, etc. Almost all parts of the plant is valuable and has potential commercial value. The leaves contain vitamin C in quantities that exceed orange, vitamin A exceeds carrot, calcium exceeding milk, and potassium exceeding banana. Another remarkable property of the plant is it full complement of essential amino acids, anti-bacterial, anti-fungal, anti-inflammatory, and antiviral properties. The seed also gives valuable oil, which has both domestic and industrial uses. Even though the plant is naturally endowed with many useful attributes, the rightharvesting and postharvest handling is required to maximize the potentials and produce moringa products with optimum quality and nutritional content. Therefore, this review aims to shed light on some of the important postharvest handling practices carried out to transform the moringa leave into finished products. Some of the practices discussed are harvesting, stripping, washing, drying, and milling. The discussion also captures ways in which theactivities affect the nutritional, medicinal, and general final quality of the moringa products.

P-010. Optimization of performance of a sweet sorghum peg-toothtype threshing cylinder

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Abstract. Box and Behnken Design employed response surface methodology to characterize the performance of the peg-tooth type threshing cylinder. Independent variables include the numberof peg-tooth, threshing cylinder speed, and concave clearance. Response variables were threshing recovery, threshing cylinder efficiency, and the amount of mechanically damaged grain. The statistical software Design Expert ® developed mathematical models that had a goodfit of actual and predicted responses. Numerical optimization revealed that the best operating conditions were 36 peg-teeth, 830 to 840 rpm threshing cylinder speed settings, and 15 mm concave clearance. Models were validated and found 99.66%, 99.59%, and 93.81% accurate forpredicting threshing recovery, threshing cylinder efficiency, and amount of mechanically damaged grain, respectively.

P-011. Optimized Utilization of Post-Harvest Coffee Agricultural Equipment and Machines

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Abstract. Indonesian coffee plantations, which dominate by smallholder plantationswith limitary production, technology, and coffee quality, concern the government. One of the Directorate General of Plantations interventions to increase market demand is post-harvest equipment and machines for coffee. This study aimed to analyze the combination of available production resources to obtain maximum benefits from assisted machinery. The resource optimization method in this study uses linear programming and is processed using POM-QM software for windows. Respondents in this study were four farmer's associations who received assistance in2017-2020 with the results of their business sustainability studies in the excellent category. The optimal production solution for farmers' associations is from a combination of products, resources, and sensitivity analysis. The optimization resultsfor green bean farmer's association 1, 2, 3, and 4 are 150 kg/month, 300 kg/month, 200 kg/month, and 759 kg/month. As for ground coffee, it is 81,3 kg/month, 83,8 kg/month, 143,3 kg/month and 272 kg/month. With this optimum level of production, it provides a profit of IDR 4,750,000 per month, IDR 2,456,250 per month, IDR 6,333,334 per month, and IDR 9,235,000 per month for farmer's association 1, 2, 3, and 4. current level of production.

P-012. Exploring the effect of different number of periods in Thailand natural rubber supply forecasting models

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Abstract. To dates, many studies attempted to forecast the price of natural rubber while many others also attempted to forecast the amount. The objective of this study was to explore the effectof different number of periods used in various forecasting models for the amount of natural rubber in Thailand. Monthly data from the Office of Agricultural Economics in the years 2007-2019 were obtained. Then the data were classified into 12 data sets; each of which had differentnumber of periods including 12, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132 and 144 months. Decomposition forecasting methods consisted of the addition divide and the multiplicative divide methods were adopted. Model accuracy indicators were the mean absolute deviation, the mean square error and the mean absolute percentage error. The results showed that the amount of natural rubber and time were positively correlated at 99% confidence level. The mostsuitable model for forecasting the amount of natural rubber in Thailand found in our study wasthe multiplicative divide method by using the number of periods at 36 months yielding the meanabsolute deviation of 66,264.61, the mean square error of 7,988,871,007.41 and the mean absolute percentage error of 24.66%.

P-013. Yield Qualities Evaluation for Gayo Arabika Coffee Germplasm

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Abstract. Gayo Arabica coffee is known as coffee that has a good taste. The germplasm at the GayoExperimental Station (GES) has the most complete collection of Arabica coffee lines in the world. This study aimed to evaluate the physicochemical and organoleptic properties of 17 arabica coffee lines in GES. The physicochemical tests were carried out at the integrated laboratory of IndonesianIndustrial and Beverage Crops Research Institute (IIBCRI), Sukabumi, West Java, on the content ofprotein, caffeine, and fat. The organoleptic testing was carried out by certified panelists referring to the Specialty Coffee Association of America (SCAA) standards. Organoleptic parameters evaluated included: fragrance, flavor, body, acidity, aftertaste, sweetness, balance, clean cup, uniformity, and overalls. The results showed that the protein content ranged from 10.79 – 14.68%, caffeine 0.51 – 0.82, and fat 12.48 – 15.94%. The organoleptic test results of semi-wet processed brewed coffee showed that all tested Arabica coffees had a total score ≥ of 80, which means they are included in the specialty category. The Ateng Super, C 49 and SLN 9 lines had a better taste (85.75) comparedto the superior varieties released, namely Gayo 1 (83.75) and Gayo 2 (85.50).

Key Words: Arabica coffee lines, germplasm, physicochemical, organoleptic.

P-014. Coating Application to Extend the Shelf Life of SweetPotatoes cv. Cilembu

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Abstract. Sweet potato (*Ipomoea batatas* L.) *cv*. Cilembu (Cilembu) is one of the commodities listed in Geographical Indications (IG) with number IDIG000000019. The specialty of Cilembu is that it tastes sweet like honey, making it attractive to the export market. The export market distribution process takes a relatively long time, so treatment is needed to maintain quality. Coating application is one of the efforts to slow down the process of respiration and transpiration which causes a decrease in quality. The purpose of the study was todetermine the best coating application made from aloe vera flour and carrageenan in maintaining the quality of Cilembu sweet potato. The stages of the research were sample preparation, coating solution making, application of coating, and observation for 30 days of shelf life. The concentration of coating solution was aloe vera (AL) 1% and 2%, and carrageenan (K) 0.01% and 0.02%. The best coating formulation was selected based on quality parameters of Cilembu, namely browning index, weight loss, total dissolved solids and hardness. Based on the value of these parameters, AL_2K_2 coating (combination of 2% aloe vera and 0.02% carrageenan) is the best coating formulation that can minimize quality loss after 30 days of room temperature storage (27°C-30°C). The application of AL_2K_2 coating can maintain a browning index of 2.3, weight loss of 7.82%, total dissolved solids 15.2° brix, and hardness of 5.59 kgf while the control (without treatment) value of these quality parameters are 4.30, 9.59%, 14.4° brix, and 5.52 kgf for each of these parameters

Keywords: *aloe vera*, carrageenan, coating, room temperature storage

P-015. Design of automatic control system on trickle irrigation for tomato cultivation

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Abstract. The development of technology has had an impact on the progress of irrigation systems, called the intelligent irrigation system 4.0. The objectives of this research are a measurement of Emission Uniformity (EU) and designing automatic irrigation based on soil water sensors. The result of EU value is in the range of 85-90%, which is a good category. EUvalue can determine whether one emitter can represent the entire emitter in one irrigation system. The principle of the soil water sensor is to read the value of the soil moisture content in the planting medium. The soil water content of 22.4%, which is the field capacity, is used as an upper limit and the soil water content of 21.1%, which is the critical point, is used as the lowerlimit. Determination of the critical point value is done by using the *management allowable depletion* (MAD) value of 0.52. The working principle of the control system is to monitor the work of the soil water sensor and become the main data to control valves, pumps, and dosing. The required cost for the automatic system is Rp. 12,626,000,-.

P-016. Assessment of potential for adoption of wireless sensor network technology for irrigation water management of high value cropsin the Philippines

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Abstract. The integration of wireless sensor network (WSN) in high value crop production systems can provide numerous benefits such as water savings, continuous and real-time monitoring of farm status, higher return on investment, and agricultural modernization. It can also address such issues as inadequate manpower, aging farmers, climate change and climate variability and can therefore contribute to sustainable crop production. This paper aims to assess the potential for adoption of WSN technology for irrigation water management of high value crops in the Philippines through market survey with farm owners and farm managers as respondents. Potential respondents were identified in various regions in the country using non-random sampling methods. An online survey and printed survey forms were used and distributed, depending on the preference of the respondent. The survey basically includes questions about farm information, problems related to water management, familiarity with WSN, and willingness to adopt, among others. Results of analysis of survey data indicate a strong potential for adoption of WSN technology. Based on the results, 83% of the respondents expressed willingness to adopt the WSN technology if properly demonstrated and if it will give a high return on investment. On the other hand, 76% of the respondents are willing to adopt WSN regardless of the costs provided there is a high return on investment. However, only a little more than half of the respondents are willing to adopt the WSN technology for the sake of modernization. Results also showed a strong potential for adoption of WSN technology using locally-developed sensors with 81% of the respondents provided affirmative answers. Chi-square test results indicated that sex, gross annual household income, membership to farmer's association, land tenure status, and familiarity with WSN technology are the primary determinants of the potential for adoption regardless of the conditions imposed. However, educational attainment also played a role in the adoption of WSN technology if the purpose is agricultural modernization and if there is a higher return on investment despite some budgetary allocation for the initial costs. Results of this study could serve as basis for developing commercialization schemes, strategies for upscaling and for agricultural policy formulation.

Keywords: wireless sensor network, market survey, WSN technology adoption, high value crops, irrigation water management

P-017. Development of Low-cost Soil Moisture Monitoring System for Efficient Irrigation Water Management of Upland Crops

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Abstract. With the advancement of information and communication technology, various types of soil moisture sensors have been developed. Coupled with data loggers, these sensors could prove useful in monitoring soil moisture in upland crop production areas which in t urn could be used for efficient irrigation water management. However, most of these sensors are costly and unaffordable to most farmers in developing countries. Hence, a low-cost soil moisture monitoring system intended to facilitate irrigation water management in upland crop production systems was developed in this study. The device was built with a capacitive soil moisture sensor, an ESP8266 Wi-Fi mini board, and a datalogging shield with RTC. Soil moisture measurements are transmitted via ESP-NOW to a server which also uses an ESP8266 Wi-Fi mini board. The low-cost soil moisture monitoring system was evaluated based on its measurement of volumetric water content and transmission of data via ESP-NOW. The performance of the capacitive soil moisture sensor was compared with the ICT International MP306 soil moisture sensor. Statistical analyses showed that volumetric water contents measured by the capacitive soil moisture sensor are comparable to those of the MP306 soil moisture sensor, thus conceived as a low-cost alternative to the high-end sensor. Moreover, test results on the range of ESP-NOW showed that data can be successfully transmitted over long distances. With regards to this, the low-cost soil moisture monitoring system may be integrated with other technologies to enable irrigation scheduling and automation for efficient irrigation water management in upland crop production systems.

P-018. Development of mobile application for wireless sensor networks for efficient irrigation water management

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Abstract. The evolution of smart phones has necessitated the development of mobile applications designed to perform a wide variety of functions. In the field of agriculture, mobile applications are currently used to monitor environmental parameters such as ambient temperatu re, humidity, soil moisture, water level, among others. A mobile application intended to monitor irrigation-related parameters and to control solenoid valves for irrigation automation was developed in this study. The mobile application was written using Flutter software development kit, and the Dart programming language. The mobile application communicates with the cloud server using a REST API written in JavaScript. The data acquired from the cloud server are presented as the current sensor reading and graphs. On the other hand, the mobile application controls the solenoid valves by sending designated bytes of data to the cloud server. The mobile application developed in this study was designed to be integrated with both low-cost sensors and the Smartmesh IP sensors to enable real-time monitoring and data visualization, and facilitate irrigation scheduling and manual irrigation control. The mobile application developed in this study may be used for efficient irrigation water management of upland crop production systems and for agricultural modernization in the Philippines and other developing countries.

Keywords: Flutter, Dart, Real-Time Monitoring, Mobile Application, Smart Irrigation

P-019. Hydraulic Performance Evaluation of Low-Cost Gravity-FedDrip Irrigation Systems Under Constant Head Conditions

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Abstract. The use of drip irrigation for upland crop production has gained popularity in developing countries due to its relatively high water-use efficiency. To maximize the efficiency of this irrigation method, it is important to evaluate its hydraulic performance in terms of emitter discharge and water distribution uniformity under various operating heads. In this study, the hydraulic performance of two locally available low-cost drip irrigation kits – *referred to in this study as Drip Kit A and Drip Kit B* – was assessed and compared under constant head conditions. Both drip kits are composed of a 1000-L intermediate bulk container (IBC) tank, 10-m submain line, 20-m lateral lines spaced 0.75 m apart, and cascade labyrinth emitters spaced 0.30 m apart along the laterals. Operating heads of 2.5, 3.5, 4.0, 4.5, 5.0, 5.5 m were used and maintained throughout the trials with the use of an overflowing tank. The submain and lateral lines were levelled (0% slope). Sampling of discharge rates was done for one-third of the total number of emitters for each of the tests performed. Results showed that the overall system emitter discharge rate generally increases with increasing operating head. Moreover, emitters farther from the submain line generated relatively lower discharge rates than those closer to it. Analysis of the experimental data showed that the Christiansen's coefficient of uniformity (CU), emission uniformity (EU), and coefficient of variation (CV) ranged from 97.5 to 98.5, 95.9 to 97.7, and 0.02 to 0.04 for the drip systems tested. Further statistical analysis also showed that varying the operating heads does not have a statistically significant effect (α=5%) on the CU, EU, and CV of the system. Based on the results, Drip Kit B performed better than Drip Kit A in terms of water distribution uniformity. However, the latter could generate higher emitter discharge rates than the former. For both drip kits, an operating head of 2.5-m is recommendable for a 200m^2 plot, from the practical standpoint. This study has generated important empirical data that could serve as basis for maximizing the performance efficiency of locally available drip irrigation systems for a more efficient irrigation water management.

P-021. Performance of structure-from-motion approach on plant phenotyping using images from smartphone

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Abstract. In recent years, 3D geometry has become increasingly important for plant phenotyping. The purpose of this study is to assess the measuring accuracy of a photogrammetric method based on SfM-MVS using a series of images captured by smartphone. Butterhead lettuce and the rubber plant were the two different plants used in this study. For each single plant, the images were captured from multiple views. A photogrammetry software took image input and converted them into 3D point cloud. Finally, the plant height was computed from the point cloud. Comparing the computed values to the actual values, the RMSE of the plant height was 0.28 and 0.43 for butterhead lettuce and the rubber plant, respectively. A correlation of $R^2 \geq 0.94$ to the reference measurement demonstrated that the photogrammetric approach is well suited for evaluation of the plant. The proposed method is simple and cost-effective by using a readily accessible device and software to reconstruct a point cloud model.

P-023. The effect of temperature distillation on products distributionderived from wood pyrolysis bio-oil

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Abstract. Bio-oil from pyrolysis of biomass can be converted to chemicals, solid carbon materials, and syngas by various thermochemical conversion technology methods. Because of the elevated temperature, bio-oil suffers drastic component changes as the first step in these processes. Understanding the impact of heating temperature on bio-oil transformation during the distillation process is critical for effective bio-oil usage. A bio-oil feedstock produced from the pyrolysis of lamtoro wood residue (LWR) at 500 °C was used in distillation from this work. Complete temperature range analysis of 96, 97, 98, 99, and 100 ºC was conducted. Eight typical compounds in bio-oil were precisely quantified by gas chromatography-mass spectroscopy (GC-MS) analysis. The results revealed that a common critical point was widely present during the distillation process, which may be attributed to a stable system generated by hydrogen bonding. As a result, the content of acetic acid, 2-Propanone, and phenol was up to 38%, 12%, and 20%, respectively. The detailed distillation characteristics and product distribution provide a comprehensive insight into the reaction process and component enrichment patterns, which can assist design and parameter optimization.

Keywords: Bio-oil, distillation, lamtoro wood residue, product distribution, temperature

P-024. Study of the use of Binahong (*Anredera cordifolia*) herbal as complementary treatment wounds in the Tenger Tribe

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Abstract. Currently, the incidence of injuries in Indonesia is quite high, as seen from the BasicHealth Research (Riskesdas) data of the Ministry of Health of the Republic of Indonesia in 2013 the incidence of injuries/injuries nationally has increased. The proportion of injuries/wounds inIndonesia is dominated by abrasions/bruises. Wound healing management can be done with conventional therapy or with complementary therapy. Complementary therapy is also known astraditional medicine or folk medicine, which consists of knowledge developed from generation to generation in various societies before the era of modern medicine. People use this therapy for reasons of belief, the existence of harmony in themselves and health promotion in complementary therapies, in addition to financial reasons, chemical drug reactions and cure rates, decision making in treatment, and improving quality of life compared to before. The nurse can act as a consultant to the client in selecting appropriate alternatives. The Tengger tribe is one ofthe tribes that still uses medicinal plants. This is supported by the ease with which medicinal plants grow in the Tengger tribal area. The purpose of this study was to analyze the implementation of wound treatment carried out by the Tengger Tribe. The design used is qualitative research with deep interview data collection methods described in narrative form. The population is the Ngadisari village community by meeting the inclusion criteria. The results showed that most of the respondents were 40-49 years old, more than half were female, more than half had a junior high school education background, most of the locations ofinjuries were on the hands, almost all of the causes of injuries were due to sharp objects, more than half the area and depth of the wound 0 ,5 – 2 cm, more than half of the time the wound occurred 1-2 years ago, most of them used complementary therapies at the time of the wound, and most used potions and drank boiled water from Binahong. It can be concluded that of all respondents who did complementary therapy, most of them did complementary therapy for wound healing by drinking binahong leaf concoction. From these results, further research should be carried out to test the content and benefits of Binahong leaves, especially for wound healing.

Keyword : Binahong Herbal, Complementary Therapy, Wound

P-025. Predation Behavior of *Myopopone castaneae SMITH* AntsAgaints Some Insect Larvae in The Laboratory

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Abstract. *Myopopone castaneae* ants are known to prey on the predatory larvae of *Oryctes rhinoceros*. These attacks are aimed at the live specimen, involving biting and stinging to death, before the hemolymph fluid is consumed. Despite the minimal information available, these ants have the potential to prey on 2.8 - 3 larvae for a period of 5 days. Therefore, the purpose of this research was to evaluate the predation behavior of *M. castaneae* ants against several types of insect larvae in the laboratory. This investigation was performed at the pest laboratory, Faculty of Agriculture, North Sumatra University from May to July 2020. The results showed a fastest prey time of 2-3 days on 3 *Omphisa fuscidentalis* larvae, while the longest was observed against *Rhynchophorus ferrugineus* species, at 3 larvae for 6-7 days. In addition, the typical predation behavior and symptoms include the presence of scars and gradual blackening on the cuticles. Moreover, ants tend to carry their offspring to the dead larvae of *O. rhinoceros* and *R. ferrugineus*, while *O. fuscidentalis* is conveyed to the nest for consumption by the colony.

P-026. Characterization of Edible Film based on Yam Bean Starch,Calcium Propionate and Agarwood *Bouya* Essential Oil

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Abstract. Fruit become defenceless against mechanical damage and water loss, causing loss ofquality and quantity. To avoid these risks, the edible coating might be one solution. The advantage of starch creates a fence between oxygen, either moisture and the product. The additional antimicrobial can be used in the coatings us calcium propionate in limited quantities. In addition, agarwood *bouya* essential oil might also have potential as an antifungal agent for fruits. This study aimed to evaluate the effect of yam bean starch, calcium propionate, and essential oil concentrations on the relevant properties of edible films. The effect of treatments analyzed by analysis of variance and significant differences between experimental groups wereexamined by Tukey HSD. As a result, the viscosity and pH of the solution were found to be in the range of 28.34 to 35.97 cP and 4.79 to 4.97, respectively. As for the film properties, moisture content ranged about 32.27 to 49.80%; L^*, a^*, and b^* values ranged from 90.22 to 91.29, 0.54 to 0.89 and 16.06 to 17.39 respectively; thickness ranged from 0.42 to 0.432 mm; WVTR ranged from 5.63 to 6.83 (g/day(m^2)), and the results of scanning electron microscopy show that it was found that the films still had the granule structure of starch.

P-028. Classification of Tomato Disease using Convolutional Neural Network

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Abstract. Agriculture is an important sector for national food needs. The main crops in agriculture include rice, wheat, potatoes, sugar cane. Other crops include nuts, fruit, vegetables,tubers and others. Plant diseases are one of the problems that always arise in the agricultural sector. Every food ingredient has the potential to have disease. Usually diseased plants will be given pesticides. Detection of plant diseases is very important. Especially if we know the type of disease from the plant. To find out the type of disease with the naked eye is quite difficult, especially since the form of the disease has a similar pattern. In this research, we propose to classify the tomato disease from its leaf with thousands of tomato images. There are three typesof analysed diseases they are bacterial spot, early blight and yellow leaf curl. We implement convolutional neural network approach to find the best classifier model. From various experiments, it was found that the neural network architecture that was built could achieve accuracy up to 87%

P-029. Drying Kinetics of Porang (Amorphophallus mueller B.) Chips under Open Sun Drying

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Abstract. The drying behavior of porang (Amorphophallus muelleri Blume) chips under open sun drying has been conducted. The aim of present study was to determine the drying kinetics and mathematical modeling of the chips and color alteration during open sun drying. The drying process was carried out for 21 hours at the open space with direct sunlight with 3, 5, and 7 mm of chips thickness variation. The average initial water content of the chips was 89.34±1.24 %wb (wet basis), and 7.77±0.44; 9.61±1.31; and 12.88±1.47% wb (wet basis) of final moisture content at the end of process for 3, 5, 7 mm of chips thickness, respectively. The nonlinear analysis for subjected model indicated that the Midilli et al model was satisfactorily describe the drying curve of the chips with following constants, i.e. a= 0.98942002; k= 0.012910112; n=2.896171324; b = 0.006416538. During drying, browning occurs on porang chips with decreased brightness index (L*) and yellowness index (b*) and increased redness index (a*).

Keywords: porang chips, Amorphophallus mueller B., drying kinetics, mathematical modeling, open sun drying

P-030. Development of a real-time wireless sensor network-basedinformation system for efficient irrigation of upland and lowland crop production systems

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Abstract. This study developed a real-time web-and WSN-based information system for efficient irrigation water management and automation of drip-irrigated upland crop and intermittently-irrigated lowland crop production systems. The web-based system uses Flutter and DART, which is an open-source software development kit that is used to develop applications for Android, iOS, Linux, Mac, Windows, Google Fuchsia, and the web. The WSN-based system uses state-of-the-art hardware and sensors for real-time monitoring of soil moisture, water level and weather conditions. The sensors are wirelessly connected in a low- power mesh network that sends data to a central server. The sensor readings are uploaded to the web application via MQTT, which generates charts and graphs for data analysis. The sensor readings were compared with measurements from conventional instruments. The system in this study can improve irrigation efficiencies under both upland and lowland crop production systems, minimize water losses and improve agricultural productivity.

Keywords: wireless sensor networks, web-based information system, drip irrigation, alternate wetting and drying

P-032. Performance evaluation of a water level sensor under variousturbidity levels in lowland crop production systems

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Abstract. The practice of alternate wetting and drying (AWD), a water-saving technology in lowland crop production systems, can be greatly facilitated using wireless water level sensors. However, these sensors generally work under clear water conditions. The sensitivity of these sensors to turbidity is important for accurate water level measurement and appropriate irrigation scheduling. This study aimed to evaluate the performance of a high -end water level sensor under various turbidity levels. The sensor is essentially of the submersible pressure transducer type which requires connection to a NeoMote system. The performance tests were performed in the laboratory using various levels of turbidity replicated three times with clear water as control. Water samples collected from a typical lowland rice production system were used to formulate various turbidity levels. The readings of the sensors were compared with manual readings for each turbidity level in all replications. Based on the data collected, analysis of variance and regression analysis were performed to analyze the stat istical significance of the differences among treatments and to establish mathematical relationships between water level measurement and turbidity. Results suggest that turbidity affects the accuracy of the water level sensor. To address the effect of turbidity on the accuracy of sensor readings, a unified calibration equation was then derived that may be used for field application under turbid water conditions. Results of this study can be used to improve the accuracy of water level monitoring in irrigated lowland crop production systems employing alternate wetting and drying technology to further increase irrigation efficiencies and augment water savings particularly during the dry season or water-scarce conditions for a more sustainable crop production.

Keywords: water level sensor; turbidity; alternate wetting and drying

P-034. Water, Food, and Energy Nexus in Lampung Province, Indonesia

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Abstract. Lampung Province's population growth rate has increased in recent decades. Population growth and mobility increase the need for water, energy, and food (WEF). Hence, maintaining food security, the level of water consumption in the agricultural sector, and energy consumption have all been considered for sustainable development. The potential of the three critical sectors can be increased using the nexus approach by taking into account several factors such as availability, accessibility, resource quality to generate positive synergies, and effectively manage losses. The Nexus approach was used to enhance decision-making for complex systems and to respond to system shocks. Furthermore, it was used to identify and eliminate contradictory policies, which are required to achieve integrated and coherent policies that address interconnected resource sectors. WEF Nexus approaches must comprehend how the trade-off and resource use efficiency that is governed affects outcomes in terms of social equity, externalities, and socio-ecological resilience. It can be done through the analysis findings, which provide information on the sustainability of WEF resources as well as recommendations for resource synergy in Lampung Province.

Keywords: Water-Energy-Food (WEF) Security, Nexus Approach, Sustainable Development

P-035. Heavy metals analysis (Cd, Pb, Zn, Cu, Cr) and calcium inPadang and Padang Panjang fresh cow's milk

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Abstract. Cow's milk is important in a healthy food intake because of its high calcium content.However, the contamination in milk can be harmful to health. The acidity of cow's milk decreases with the increase of heavy metals concentration that is poisonous to the body. This research aims to investigate the content of heavy metals (Cd, Pb, Zn, Cu, Cr) and minerals Ca contained in fresh cow's milk samples from two different locations, which are Padang city and Padang Panjang city. The quantitative method used in this research is Atomic Absorption Spectroscopy (SSA). The average heavy metal and Ca minerals contained in samples of fresh milk from the Lubuk Minturun area are: cadmium (Cd) not detected, lead (Pb) 13.58±1.01 ppm, zinc (Zn) 28.83±1.81 ppm, copper (Cu) 1.17±0.38 ppm, chromium (Cr) not detected, andcalcium (Ca) 674.00±2.46 ppm. Meanwhile, fresh milk samples from Padang Panjang area: cadmium (Cd) not detected, Pb 20.58±2.02 ppm, Zn 53.08±2.40 ppm, Cu 2.17±0.38 ppm, chromium (Cr) not detected, and Ca 504.25±2.63 ppm. All samples from both regions showed heavy metal content of Pb, Zn, and Cu which exceeded the maximum limit set by the Environmental Protection Agency (EPA), consequently it could cause negative impacts on health when consumed. This is assumed to be caused by cattle food contamination by garbage and pesticides which requires further research.

Keywords: fresh milk, heavy metals, calcium, SSA

P-037. Effect of Production Technique on Corncob Biochar Quality

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Abstract. South Lampung Regency is one of the centers of corn production in the province of Lampung, Indonesia. Along with the increase in production, the resulting biomass waste also increases. Corn production biomass waste such as cobs can be utilized into more useful products such as biochar which is useful as a soil amendment. The quality of biochar is determined by the temperature and the period of pyrolysis which is greatly influenced by the selected production technique. The purpose of this study is to evaluate the quality of biochar based on its production technique. The three production techniques used are traditional soil pit, closed and open drum kilns. The results obtained show that the closed drum kilns technique produces biochar with better properties for increasing soil fertility.

Keywords: Corncob, Biochar, Soil Fertility

P-039. Discrimination Between Arabica and Robusta Coffees Using NIR-Integrating Sphere Spectroscopy Coupled with Hierarchical Clustering Analysis

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Abstract. In Indonesia, coffee farmers preferred to produce arabica and robusta coffee. Regarding its superior quality and commercial values, now the production of arabica coffee is increasing. In this research, discrimination between the two coffees was evaluated using NIR-integrating sphere spectroscopy coupled with the hierarchical clustering analysis (HCA) method. NIR spectral data inthe region of 1175-1650 nm was measured using a portable fiber optic NIR spectrometer equippedwith an integrating sphere from Ocean Optics (NIR-Quest, Ocean Optics, USA). Arabica (n=10) and robusta (n=10) ground roasted coffee (with mesh 50) was prepared as samples. The principal component analysis (PCA) and hierarchical cluster analysis (HCA) were utilized in data analysis to discriminate between the arabica and robusta coffee samples. The PCA and HCA results confirmed the good separation between the two coffees with arabica and robusta coffee samples were grouped in two distinct clusters. This result reveals that NIR-integrating sphere spectroscopyseems to be a potential analytical method dedicated to the discrimination of arabica and robusta coffee with minimum sample preparation.

Keywords: arabica coffee, HCA, NIR spectroscopy, PCA, robusta coffee

P-040. UV Spectral Analysis Coupled with PCA-LDA to Authenticate Organic and Conventional Lampung Robusta Coffee

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Abstract. This work presents a simple analytical method for authenticating organic and conventional coffee samples from different origins. UV preprocessed spectral was used to discriminate between organic Lampung robusta coffee from Lampung Barat (n=50) and two conventional Lampung robusta coffees from Lampung Barat (n=50) and Tanggamus (n=50). Ground roasted coffee samples with 50 mesh were used for samples. UV-vis spectrometer was utilized to acquire UV spectral data from an aqueous coffee sample. A chemometric method based on PCA and PCA-LDA algorithm was used to classify the samples. The PCA result shows all organic coffee samples were clustered on the positive of PC1. The conventional coffee samples from Lampung Barat and Tanggamus were grouped on the negative of PC1 in different clusters according to their origin. The PCA-LDA resulted in a 100% accuracy in classification both for calibration and prediction. This method is a promising approach for organic and conventional Lampung robusta authentication with a relatively low-cost spectrometer and simple sample preparation.

Keywords: conventional coffee, organic coffee, PCA, PCA-LDA, UV spectroscopy

P-041. Veris 3100 application for determining the fertility of rice fields before land preparation.

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Abstract. Agriculture 4.0 demands the development of technology and science to continue to develop in the agriculture. Agriculture 4.0 applies the use of the latest technology to increase efficiency in agriculture both in terms of on-farm and off-farm. Provision of fertilizers and plant nutrients is an important factor in plant growth, but the fertilizer and nutrient needs of each block of the plant have different amounts depending on the condition of the soil condition and environment such as local climate. Generally physical measurements of soil done in laboratory which are laborious in sampling, takes a long time for analysis and costly. Nowdays there are some EC, PH, moisture sensor based on probe. However this method cannot give results in real time also. Electrical conductivity of the soil (EC) have closed relation with physical and chemical properties of soil. Veris 3100 is one instrument that can measure EC for those purposes. This paper describe the results of EC measurements by Veris 3100 and spot measurements carried out using EC, PH and moisture content probes.

Keywords: EC Soil, Real time, Precission agriculture, Base vertilization

P-043. The Quality of Arabica Coffee Beans Evaluation in Luwu Regency South Sulawesi,Indonesia

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Abstract

Arabica coffee plantations in Luwu Regency are planted at elevations above 1,000 mdpl, so that the Arabica coffee clones planted can produce high-quality coffee flavors. The aims of this study were to determine the physical, chemical, and taste profile of Arabica coffee Luwuin order to increase the added value and competitiveness of the product. The research was conducted using a survey method on Arabica coffee plantations in Latimojong District, Luwu Regency, South Sulawesi Province. Sampling using purposive random sampling method and analyzed in duplicate. Samples of coffee variants were obtained from several farmers and from several levels of the coffee trade system around Luwu Regency. Analysis of physical quality characters includes levels of live insects, foul-smelling seeds/mold, moisture content, dirt content, and special quality requirements on seed size, number of seed chips, and defectvalues. The chemical analysis includes water, ash, caffeine, protein, and fat. The taste of brewed coffee in an organoleptic manner refers to the Specialty Coffee Association of America/SCA standard covering aroma/fragrance, flavor, body, acidity, aftertaste, sweetness,balance, clean cup, uniformity, and overall. Based on the results of the study, the coffee beansmet the general quality requirements, there were no live insects, no foul-smelling and/or moldy beans, moisture content of 12.5% , and a maximum dirt content of 0.5%. The value of ash content is 4.344%-5.514%, fat content is 11.194%-14.067%, the highest protein content is 11.687%-13.719%, the highest caffeine content is 0.041%-0.064%. The results ofthe taste test showed that ten samples had the potential for specialty coffee with a score above 8 and two samples below a score of 8.

Keywords: Arabica Coffee, coffee processing, Luwu regency, specialty coffee

P-044. The Potential of Sustainable Biogas Production from Macroalgae in Indonesia

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Abstract. Indonesia is one of the world's major seaweed producers, contributing to 38% of the global seaweed market. Indonesia increased its seaweed farming output from less than 4 million tons in 2010 to over 11 million tons in 2015 and 2016 and expected to continue rise to 13 million tons by 2024. The contribution of seaweed products is quite large, which is 60.7% of the total national aquaculture production. To achieve sustainable energy development goals in many developing countries including Indonesia, the implementation of biomass to energy technology such as the production of biogas form macroalgae has been considered as one of the best options. Therefore, this article aims to highlight the potential application of biomass to energy technology via the production of biogas from macroalgae as an alternative source of power generation in Indonesia. Indonesia's energy mix and several issues regarding the macroalgae production are comprehensively reviewed. Additionally, this article also discussed the current status in Indonesia's energy generation from new and renewable energy resources. Several key technologies on how to utilize macroalgae for biogas production are presented. Finally, this paper also highlights several main challenges faces in the implementation of biogas production in Indonesia.

Keywords: biogas, macroalgae, Indonesia, renewable energy

P-045. The Effect of Biofertilizer from Waste Bioconversion on The Growth of Cocoa Seedlings

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Abstract. Organic waste can be a source of environmental pollution if not managed properly. The organic waste transformed by Black Soldier Fly (BSF) larvae produces liquid biofertilizer (LB) containing nutrients and beneficial microbes for plants. This study aims to determine the effect of dosage and frequency of application of liquid biofertilizer on the growth of cocoa seedlings and soil properties. The experiment used a randomized complete block design with seven treatments and four replications. The treatments were a control, LB 3% every two weeks, LB 3% every four weeks, LB 6% every two weeks, LB 6% every four weeks, LB 12% every two weeks, LB 12% every four weeks. The results showed that LB 6% every four weeks was the best treatment in increasing seedling height, stem diameter, and weight of fresh shoot, dry shoot, and dry roots of cocoa seedlings at 20 weeks old compared to other treatment. The application of LB significantly increased soil pH, but not significantly effected on the content of organic C, total N, available P and exchangeable cations at soil. Biofertilizer from bioconversion of organic waste using BSF larvae is suitable to improve the growth of cocoa seedlings.

Keywords: Black Soldier Fly larvae, biofertilizer, cocoa

P-047. Design of 'ready-to-pack' deep frying machine

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Abstract. Food processing by applying high temperatures can eliminate most microbes and inactivate enzymes that can cause spoilage. Food processing tools and machines have an important role to provide better quality results and carried out more efficiently and effectively.This study aimed to obtain and analyze data also to create design documentation for a 'ready- to-pack' deep frying machine. Data were collected by means of observation, interviews, and documentations. Data analysis was carried out by processing the collected data with mathematical calculations. The design documentation process was done using Solidworkss software. This 'ready-to-pack' deep frying machine had been successfully designed and was expected to facilitate the frying process and simultaneously proceed with the spinning process.This machine was designed to use a 0.373 kW motor, constructed from stainless steel and angle bars and hollows. The analysis results of the shaft planning data at a minimum diameter of 9.06 mm and the use of 25 mm-diameter shaft were declared safe with a stress analysis on the frame of 1.065×10^7 N/m^2 which was still below its maximum stress. Therefore, the machine could be constructed based on this design and analysis

Keywords: analysis, deep fryer, design, machine, spinner

P-048. Assessment of Water Availability for Rice Cultivation in South Lampung Regency

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Abstract. The availability of water for rice cultivation is influenced by climatic conditions. Climate change will have a significant impact on rice production in areas where water resource infrastructure is inadequate. South Lampung Regency is primarily a rain-fed rice production region. As a result, an assessment of water availability for rice cultivation is required for sustainable rice production. This study aims to provide recommendations to the government in carrying out the necessary infrastructure development. This study uses secondary data such as rainfall, temperature, solar radiation, evaporation, and humidity from 2010-2020. The study's findings provide information on the sufficiency of water availability for rice cultivation in each sub-district in the South Lampung Regency, as well as scenarios for developing water resources infrastructure.

P-049. Study on pigment coaction of nipa palm (*Nypa frutican*) andprimrose willow (*Ludwigia peruviana*) to improve the efficiency of dye sensitized solar cells (DSSC)

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Abstract. Nipa palm (NP) (*Nypa fruticans*) and primrose willow (KR) (*Ludwigia peruviana*) are are potential to be used as a source of sensitizer for DSSC since both of them has natural green and yellow pigment. The green and yellow natural dyes used as sensitizer were extracted from leaves (DN), flowers (BG) and fruits (BH) of nipa and leaves (DN) and flowers (BG) of primrose willow. All extracts from each part of plant were combine into 6 combination which was DN-NP+BH-NP, DN-KR+BG-NP, BG-KR+ DN-NP, DN-NP+BG -NP, DN-KR+BH-NPand DN-KR+BG-KR and singular extract which was BH-NP, DN-NP, BG-NP, DN-KR and BG-KR. The result showed that from the 6 extract combinations, the value of power conversion efficiency (η %) were obtained for the coaction were 2.53%, 1.25%, 0.51%, 0.51%, 0.42%, and 0.29% respectively. However, the value of power conversion efficiency of singular extract was 1.33%, 1.10%, 0.35%, 0.52% and 0,49% respectively. In conclusion, the coaction of two natural dyes can increase efficiency compared to a single natural dye, except for the co-action of DN-KR+BH-NP and DN-KR+BG-KR.

Keywords: DSSC, Nipa palm, pigment co-action, primrose willow, sensitizer

P-053. Life cycle cost analysis of Local Rice Production Scenarios for Bangka Regency, Indonesia

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Abstract. Currently, rice is the main staple food for Indonesian people and produced in every Island in Indonesia. Rice production are consisting of several activities such as: cultivation by farmers, processed inmilling factory, post-harvest, and selling to the customers. Cost calculation for overall production process are important for cost evaluation in every rice production. The aim of this research was to use life cycle cost analysis for rice production scenario for two cultivars (Mapan 05 and Inpari 32) in Bangka Regency, Indonesia. Life cycle cost scenario was used in this research was 240 scenarios with three main production scenario such as: production with mechanization, production with semi-mechanization, and production with manual (local technology). Rice Production stages was set as system boundary that consist of (1) land preparation, (2) cultivation, and (3) post-harvest to produce white rice. The result of this study was the lowest LCC was IDR 5,765.72 kg^{-1} and IDR 6,237.97 kg^{-1} for Mapan 05 and Inpari 32 cultivars.

Keywords: Bangka, life cycle cost, production cost

P-055. Design Development of Portable (Mini) Multifunction Incinerator as Continues Burner for Medical Waste Handling

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Abstract. Public health services (PUSKESMAS = Pusat Kesehatan Masyarakat) or other health center tend to be the toxic waste producer, which some of them are labeled as hazardous and toxic waste (B3) which eventually cause environmental pollution. One of the possible solution is to burn the waste by using incinerator. Basically, incinerator is a waste burner which was using high temperature, thus it could be perfect to burn out medical waste. Heat energy that exposed while incinerator operated should having high potency to be used for other purposes such for water heater and carbonization process. This research aims to develop an incinerator which can be used not only as high temperature burner (as incinerator's main function), but also for water heater system and carbonization process in the same time. The incinerator designed as mini portable incinerator since it will be used in a public health services (PUSKESMAS)). Combustion process temperatures, smoke quality, safety factor, and energy utilities are the parameters which determined as incinerator performance. A mixture of patchwork waste and plastic bottles was used for performance test of the improved incinerator, since the use of B3 waste in campus is not possible. The result of performance test showing that combustion temperature successfully increased up to 980 ^{0}C for combustion rate of 9 kg/hour. Utilization of heat energy produced by combustion process inside the chamber, successfully produce 2-2,5 kg of good quality coconut shell charcoal and hot water of 86 ^{0}C at 0,018 lt/hour flow rate. Those performance is better compared to the original design and several improvements that has been done before.

Keywords: multifunction, portable, incinerator, toxic

P-056. Food Safety Aspect in the Use of Hydrogen Peroxide in theCleaning Process of Coriander Seeds

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Abstract. Eventhough coriander is one of important spices for Indonesian traditional cuisine, itis mostly obtained from others countries. One problem related to imported coriander is its appearance which is dark in color and dirty so it does not meet Indonesians consumers preferences. To improve the appearance of imported coriander, importers usually threat the herb by cleaning them using hydrogen peroxide (H2O2) , a compound known as a heavy metal and strong oxidation. Unfortunately, there is no standard formula or procedure to apply hydrogen peroxide as cleaning agent for herbs. This condition causes the cleaning process increases potential risk of hydrogen peroxide residual contamination on coriander seeds, which does not meet the food safety requirements. This research was carried out by conducting experiments to clean coriander in the laboratory with the treatment of various doses and concentrations of hydrogen peroxide, variations in drying methods and duration of temporary storage. The best treatment combination was selected based on the final color of coriander seeds according to the consumers preference, the lowest residual hydrogen peroxide and the shortest temporary storage time related to the reduction of hydrogen peroxide residue. The result of parameter measured shows that hydrogen peroxide treatment did not give a significant change to the nutritional value. The higher concentration of hydrogen peroxide treatment combined with artificial drying resulted in brighter coriander seeds and more effective brightness achievement. Treatment of hydrogen peroxide with a higher concentration resulted in a higher residual value. Artificial drying method with a temperature of 50 ºC gives the effectof decreasing the residual value of hydrogen peroxide more quickly. The residual value of hydrogen peroxide in coriander seeds decreased directly proportional to the addition of post- treatment shelf life. All treatment variations reached the allowable residual value according to EPA standards at 30 days after treatment.

Keywords: cleaning, color, coriander, food safety, hydrogen peroxide

P-057. Development of the turn algorithm of an autonomous combine harvester at the corner of paddy fields

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Abstract. One of the problems that occur in harvesting rice using a combine harvester is when at the corner of the paddy field, especially in harvesting the outermost path. The outermost harvesting path is very close to the edge of the paddy field so that the free space for its maneuver is very limited. This study aims to develop an algorithm to overcome difficulties when the combine harvester turns at the corner of paddy field. The turning algorithm is designed in two methods, namely combine turning 90o without backward movement and turning 90o with backward movement. The first method is applied to several paths closest to the paddy field bunds while the second method is applied to the remaining paths close to the midpoint of the paddy fields. The reason for applying the second method in the middle of the paddy filed is that there is sufficient free space for backward movement. The combination of the two methods was tested on a simulated paddy field are of 225 m2. The test results of the combination of the two turning methods showed that the total area of the plant that was not cut was 3.25 m2 with an average turning time 12.4 seconds.

Keywords: autonomous combine, corner approaching, corner turning

P-058. Preliminary Assessment of Land Quality Index of the PaddyField Around Jember Regency

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Abstract. Land conversion causes a decrease in the occupation of paddy fields areas. Furthermore, the existing paddy fields that are mismanaged cause land degradation also. This study assesses the land quality index (LQI) in Jember Regency, East Java, Indonesia. Input data for this study consist of land cover, soil type, and slope maps. The procedure to calculate the land quality index (LQI) include (1) spatial analysis to create the unit soil map area, (2) preparing soil sampling, (3) field survey, (4) soil chemical analysis in the laboratories, (5) scoring of paddy field condition, (6) principal component analysis (PCA), and (5) reclass the land quality index (SQI). The PCA results show that three variables (i.e., slope, irrigation infrastructure, and flood hazard) strongly correlate to LQI. Then, four classes (very low, low, medium, and good) of LQI describe the spatial variability of the paddy field. The results show that about 1.05% of the paddy field area is categorised in a very low LQI class. Then a low- class LQI covers approximately 13.83%, a medium-class about 42.92%, and 42.2 % of the paddy field categorised as the good LQI. Management of irrigation infrastructure and planting perennials in upstream areas can be carried out to improve land quality

P-059. Using sentinel and comparing two classification algorithms forland cover mapping in the area dominated by small scale heterogeneous agricultural land

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Abstract. Sentinel images are widely used for monitoring and mapping our environment phenomenon. The imagery applies in land-use and land cover mapping using pixel-based classification, image segmentation, or other image interpretation algorithms. One type of algorithm may be more suitable for a specific area, which depends on many factors. This study aims to analyse and compare two classification algorithms for land cover (LC) mapping in the region characterised by a small scale type of agricultural land occupation. The primary input for this study is the Sentinel 2A image. Two well-known pixel-based classification algorithms, i.e., Maximum Likelihood classifier (MLC) and ECHO (Extraction and Classification of Homogeneous Objects), are used and are compared. The study covers an area of 3320.3 km^2. The classification result produces nine (9) land cover classes, i.e., (1) pavement or urban area, (2) heterogeneous agricultural land, (3) irrigated paddy, (4) open water body, (5) dense vegetation or forest, (6) sparse vegetation or plantation, (7)shrubland or dry-land, (8) wetlands, and (9) sand-clay-rock. Classification using MLCand ECHO produced kappa and overall accuracies of more than 90%. In general, bothof the two algorithms can produce a relatively similar area extend for each class. However, two classes, i.e., (2) heterogeneous agricultural land and (6) sparse vegetation, are still tricky to distinguished.

P-060. Conventional and sensor-based streamflow data acquisitionsystem for sustainable water resources management and agricultural applications: an extensive review of literature

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Abstract. This paper presents an extensive review of literature of conventional and sensor-based methods for streamflow data collection intended for sustainable water resources management and agricultural applications. Conventional methods reviewed include timed volume method; velocity-area method including float method, dilution gauging method, trajectory method, current meter method, acoustic Doppler current profiler and electromagnetic method; formed constriction or constricted flow methods or non-contact approaches such as remote sensing and particle image velocimetry. This paper also presents a review of published literature on local studies in the Philippines that employed sensor-based measurement of streamflow for water resources management. A comparative analysis of the various methods was then made based on their applicability with respect to the characteristics of the streams, ease of operation, effectiveness, accuracy, and the cost. The review of each method's strengths and weaknesses suggests that as practiced, the timed volume method is suitable for hilly terrain with smaller streams due to its operational ease and accuracy. Although relatively costly, formed constriction or structural methods are suitable for long term studies of small hill streams, since it gives accurate results once the structure is properly put in place. In flat, unobstructed terrain, the float method is best due to its operational ease and cost effectiveness, whereas, for larger streams, the particle image velocimetry may be used. While sensor-based methods represent the modern methods and provide convenience and efficiency in streamflow data collection, they, however, require actual observed data for calibration, correction and updating, which pose additional burden to the user. The review suggests that the selection of the most suitable method for monitoring streamflow may still be based on the characteristics of the stream i.e., volume and accessibility of the terrain, accuracy of the method, application, and financial and physical resources available. Finally, recommendations are offered to maximize the potential applicability of the most effective methods for sustainable water resources management and agricultural applications particularly in developing countries.

Keywords: Streamflow, streamflow data acquisition system, Streamflow monitoring, sensor networks, sensor network applications

P-061. Land cover and vegetation mapping of tropical forest areas usinghigh resolution imagery in Central Borneo

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Abstract. This study aims to analyse and compare land cover (LC) classification results of tropical forested areas in Central Borneo using high resolution imagery. In this study, Pleidas image (spatial resolution less than 1m per pixels) is use as main input. A neural network – multi layer percepation (NN-MLP) algorithm is used and is compared with two well-known pixel-based classification algorithms, i.e., Maximum Likelihood classifier (MLC) and ECHO (Extraction and Classification of Homogeneous Objects). The ECHO are varied using (2x2; 4x4; and 6x6) homogeneous pixel group. The study covers an area of 162.60 km^2 located in the Central Borneo. The classification result produces nine (9) land cover class, i.e., pavement, sparse vegetation, dense vegetation, bare land, palm oil plantation, mixture grass, sand , miningarea, and water body. Classification using NN-MLP, MLC and ECHO produced kappa and overall accuracies more than 90%. In general, the three algorithms can produce a relatively similar area extend for each class. However, the ECHO 2x2 shows best performance than otheralgorithms.

P-062. Prediction of Cocoa Fermentation Level Non-Descriptive with Near Infra-Red Spectroscopy

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Fast and efficient detection of fermentation rates can be realized through Near Infrared Spectroscopy (NIRS) technology by measuring the reducing sugar content of fermented cocoa beans. The purpose of this study was to determine the best calibration model of the Partial Least Squares (PLS) and Principal Component Regression (PCR) methods that can be used todetermine reducing sugar content and analyze the correlation of reducing sugar content with fermentation time of cocoa beans. The correlation of NIRS reflectance data with reducing sugarcontent of cocoa beans was processed using five pre-processing, namely Normalization, Dg1,Dg2, Multiple Scatter Correction (MSC) and Combination of Normalization and Dg1. The PLSmethod with MSC data processing factor 7 has the values of R2, rk, SEC, rv, SEP, Consistencyand RPD respectively 0,7413, 0,9115, 0,0855, 0,9449, 0,1037, 82,4312, 2,1904. The PCR method with data processing Normalization factor 9 has R2, rk, SEC, rv, SEP, Consistency andRDP values of 0,5823, 0,8511, 0,0002, 0,9222, 0,0002, 98,5492, 1,9550. Estimation of reducing sugar content using NIRS can be done. PLS is better than PCR for predicting reducingsugar content. Reducing sugar content can be used as an indicator based on discriminant analysis. But, discriminant analysis has not been able to categorize the level of fermentation based on the day of fermentation.

Keywords: Discriminant Analysis, Fermentation, Reducing Sugar, PCR, PLS

P-063. Development Software to Evaluate Environmental Impact for Palm Oil (*Elaeis guineensis Jacq*) Industry using Life Cycle Assessment Approach in Indonesia

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Abstract. Palm oil in Indonesia are producing the Crude Palm Oil (CPO) with the highest export in the world. CPO production in Indonesia are increasing from 17,77 million to 31,49 million tons from 2013 to 2013 and still increases. Currently Indonesian government projected to use palm oil as source to produce biodiesel to replace the fossil fuel. However, to evaluate the production of biodiesel from palm oil should consider the environmental aspect. Life cycle assessment are appropriate tools to evaluate the overall productions environmental impact in palm oil industry. In this research, we proposed a software to life cycle assessment applicationin palm oil industry in Indonesia. The method was used in this study are prototyping that consist of the iteration analysis, design, coding and testing. The result of this study was the software toevaluate the environmental impact using life cycle assessment approach. Software was able to perform life cycle assessment activity such as goal scope definition, inventory data, life cycle impact assessment and interpretations.

Keyword: crude palm oil, lifecycle assessment, palm oil, software

P-065. Detection of Mechanical Damage in Avocado Fruit Using Ultrasonic Method

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Abstract. One of the obstacles in controlling the quality of fresh avocados is the lack of non-destructive technology to identify mechanical damage in avocados. So the aim of this study was to assess the ultrasonic method to evaluate mechanical damage in avocados. Ultrasonic velocity and attenuation were measured by ultrasonic transmission equipment at a frequency of 50 kHz. The signal transmitted by the avocado was sampled at a sampling rate of 0.1 ms. Avocados were cut and classified as either good or damaged avocados. Fast Fourier Transform was also applied to determine zero moment power. Discriminant analysis was performed to classify good and damaged avocado based on ultrasonic properties. The ultrasound velocity of good avocado is 322.32 m/s which is higher than that of damaged avocado (316.78 m/s). The good avocado attenuation is 22.66 Np/m while the damaged avocado is 23.57 Np/m. The zero moment power of the good avocado is 13.04 while the damaged avocado is 11.51. Discriminant analysis using ultrasound velocity and zero moment power was successful in classifying good and damaged avocado with 100% accuracy.

Keywords: damaged avocado, discriminant analysis, ultrasound, zero moment power

P-066. Effect of Chemometrics to Accuracy of NIR Spectroscopy in Predicting Total Soluble Solid and Hardness of Dragon Fruit

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Abstract. NIR spectroscopy was assessed to determine the total soluble solids (TSS) and hardness of the dragon fruit nondestructively. Dragon fruit reflectance (n=90) was measured by FT NIR Spectrometer, and after that TSS and hardness of dragon fruit were measured destructively with digital refractometer and rheometer, respectively. Chemometrics was applied to get the best predictions of TSS and hardness of dragon fruit. The chemometrics applied included six spectral pretreatments and the number of PLS factors to calibrate the spectral data for TSS and dragon fruit hardness. The hardness range of dragon fruit is 8.73-24.91 N and TSS of 9.20-17.60 brix. The results showed that some spectral pretreatments slightly increased the accuracy of NIR spectroscopy in predicting dragon fruit TSS. However, there is no spectral pretreatment that can improve accuracy in predicting dragon fruit hardness. Increasing the number of PLS factors may increase the accuracy for a while but after that it decreases. The optimum number of PLS factors is 16 to predict TSS, and 17 to predict dragon fruit hardness. NIR spectroscopy can be used to determine TSS (r=0.93, SEP=0.66 brix, RPD=2.09) and hardness (r=0.89, SEP=1.75 N, RPD=2.02) of dragon fruit nondestructively.

Keywords: dragon fruit, NIR, PLS, spectral pretreatment

P-067. Vis/NIR spectroscopy for non-destructive method in detecting soybean viability

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Abstract. The purpose of this study was to use study the potency of the modular Vis/NIR spectroscopy for determining viability of soybean seeds. Vis/NIR spectra of soybean seeds were collected and analysed using partial least squares discriminant analysis (PLS-DA) for discriminating non-viable soybean seeds from viable ones. The optimal classification models developed were compared with various spectral pre-processing methods. The result showed that the modular Vis/NIR spectroscopy performed perfectly (Accuracy and Reliability of 100%) in detecting soybean viability. The study showed that the Vis/NIR spectroscopy coupled with chemometric analysis are potential for rapid detection of viability of soybean seeds

P-068. Design and Performance Test of Autonomous Precision Spraying Robot for Cabbage Cultivation

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Abstract. This study was conducted to analyze the performance of an autonomous robot that has been designed to precisely spray pesticides on cabbage. The robot can walk straight along the walls of the cabbage beds with a forward speed of 0.226-0.227 m/s using wall-follower navigation system and can spray pesticide solutions with an average droplet diameter of 382 microns. Spraying is done one by one plant using the machine vision method to detect plants. The spraying volume is controlled based on the input of the cabbage canopy area that is sprayed.The robot uses Arduino mega as the main controller, raspberry pi 4, pressure sensor, distance sensor, rotation speed sensor, and compass sensor to support the robot's performance. The accuracy of the spraying output volume is 95.57%, the average spraying instruction accuracy is88.1%, and the accuracy of the spraying position is 80.57%. Spraying volume (L/Ha) produced by the robot can approach the reference value compared to farmworkers. The field efficiency produced by robots is 84.75% and 96.65% by farmworkers.

Keyword: Agriculture, Autonomous robot, Object detection, Precision spraying

P-069. Design and performance test of biodiesel reactor using helicalscrew agitator and baffles

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Abstract. Biodiesel reactor model using helical screw agitator and baffles have been designed. The helical screw type is chosen based on the agitation ability on viscous liquid with low energy, while baffles is purposed to generate homogeneous mixing. The objectives of the research was to obtained biodiesel reactor model and determined the best operation of reactorin producing biodiesel. Performance test of biodiesel reactor was done at 10 rotation speed levels of agitator, at range of 100 rpm until 1000 rpm. Biodiesel was produced by catalytic method, with 1.5 % w/w KOH catalyst at temperature ranging from 60ºC to 65ºC, for 60 minutes. The research obtained model of cylindrical biodiesel reactor with the height of 30 cm and 17 cm diameter. The helical screw agitator has 4 screws and equipped 3 baffles installed atthe reactor wall. Based on the saponification value analysis, the biodiesel contained 99 % w/w methyl ester. The best operation of biodiesel production was resulted at 100 rpm which has the lowest energy consumption.

P-070. Delignification of Cassava Peel as Bioethanol RawMaterial using Combined Alkali and Microwave HeatingMethods

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Abstract. Indonesia is ranked fourth as the largest cassava producing country with a total production of around 20 million tons per year. As much as 15-20% per kilogram of cassava is waste in the form of cassava peel which containsstarch and allows it to be converted into alternative energy such as bioethanol. The bioethanol production process is carried out through the stages of pretreatment (delignification) to obtain cellulose used in the hydrolysis process, hydrolysis, fermentation, and purification. This paper will discuss the use of combined alkali and microwave heating methods to increase the cellulose content and reduce the lignin content of cassava peel. Delignification was carried out by varying the NaOH concentration of 0.5, 0.75, and 1 M and microwave exposure of 5, 10, and 15 minutes. The data of the pretreatment variation were statistically tested using a completely randomized design. The results shows that combined alkali and microwave heating methods was able to increase cellulose content from 39.78 to 59.01 %, decrease hemicellulose content from 24.75 to 12.79 %, and decrease lignin content from 23.28 to 14.66 %. The combination of1 M NaOH and 15 minutes' microwave exposure showed the best results.

Keywords: alkali, bioethanol, delignification, cassava peel, microwave heating

P-071. Abnormal Shapes Identification of Mango Gedong Using Non-dimensional Shape Factors in Image Processing

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In addition to size, export quality requirements for gedong mango among others are clean surface, free of damaged mechanically or biologically, free from pests and diseases, and normal fruit shape. The abnormal fruit shape in mangoes is known as sitting mango, which is not easy to roll over when pushed because the fruit surface is flat on certain sides. Several dimensionless shape factors can be used to identify the shape of an object through image processing. Some shape factors that are often used to identify shapes of object in image processing include roundness, roundness ratio, sphericity, axial ratio, inequality degree of projected area and spherical disproportion. This study aims to identify the shape of the fruit using several dimensionless shape factors and determine the shape factors that can be used to distinguish normal and abnormal fruit shapes for gedong mangoes. The results showed that abnormal and normal mango gedong fruit shapes could be distinguished by image processing using the roundness, sphericity, and spherical disproportion form factors in certain deviant shapes but not for all samples.

P-072. Utilization of anaerobically digested dairy manure wastewaterfor *Spirulina maxima* cultivation

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Abstract. Microalgae have attracted the attention of the scientist as microalgae have higher productivities than terrestrial plants. Microalgae can be used to produce several valuable commodities such as bioenergy, feed, and food. Enhancing the economic feasibility of microalgae-based products can be done by coupling the growth medium with wastewater. In this research, *Spirulina maxima* were cultivated using effluent from anaerobically digested dairy manure wastewater (ADDMW) at concentrations 0, 50, and 100%. The growth curve wasmonitored by measuring the dried biomass weight every three days. Results showed that the *S. maxima* growth in manure wastewater was insignificantly different from *S. maxima* growth in Zarouk medium (2.090 $g.L^{-1}$ and 1.933 $g.L^{-1}$, respectively). Phycocyanin, one of the primary pigments of S. maxima, was determined to evaluate the effect of wastewater medium on phycocyanin production. The phycocyanin content of *S. maxima* in 0, 50, and 100% wastewater was insignificantly different (58.67, 56.51, and 54.67 $mg.L^{-1}$ culture, respectively). This study provides insight into the potential use of anaerobically digested dairy manure wastewater as the growth medium of *S. maxima* and substitutes the commercial medium.

Keywords: *Spirulina maxima*, anaerobically digested dairy manure wastewater, phycocyanin

P-073. Development of Deep Learning Models on the Navigation System for Assistant Harvesting Robot

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Abstract. Greenhouse farming can be more profitable if automation, computer and robotics technologies are applied to its environment. One of the robots specifically designed for the greenhouse environment is the robot for support harvesting process. The robot has the function of following the harvester and can carry the harvested product. This study has developed a navigation system for assistant robot using object detection based on deep learning. The image processing program uses the Python programming language and the deep learning models that have been tested on robots are SSDMobileNet v2, Pednet, and Multiped. The deep learning model runs on the Jetson Nano device. The best detection results on SSDMobilenet v2 with mean average precision of model is 72.7% and the sample detection accuracy is 88%.

P-074. Estimation of Potassium Nutrient Content In Tea Plants UsingSentinel-2 Satellite Imagery

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ABSTRACT. Tea plant (*Camellia sinensis*) is a plantation crop commodity that has a significant role in Indonesiantea industry. Currently, the determination of a single dose of potassium fertilizer on a tea plant begins with soil and leaf laboratory analysis. The cost of laboratory analysis for testing nutritional contentof potassium in a tea plant has always been a challenge for many farmers. the necessity of minimizing the estimate of nutritional content of potassium in tea plants affordably and accurately is the goal of this study. This study aims to estimate the nutrient content of potassium in tea plants using sentinel-2 satellite imagery. The study began by sampling tea leaves and taking satellite images. The data obtained were then correlated with multiple linear regression analysis to create a model. The model obtained is K% = 0.619 + 0.001876 b3 - 0.001264 b4 - 0.000201 b8, using the grouped data for the maximum time distance of sampling with image acquisition for 5 days and processed using backward regression method. The coefficient of determination (R-sq) obtained is classified as moderate at 50.18%. the model was validated and well characterized in making estimates with a MAPE percentage of 15.18% and a correctness of 84.82%

Keywords: Image, model, potassium, *sentinel-2,* tea.

P-075. Artificial Neural Network Model to Estimate Growth of Melon (Cucumis melo L.) duringVegetative Stage in Greenhouse with Evaporative Cooling

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Abstract. Currently, melon is a high economic value product in Indonesia. To optimize the production of melon, cultivation in greenhouses equipped with evaporative cooling system is implemented in some locations. However, growth of melon in greenhouse with evaporative cooling is characterized by complexity in its relation with environmental parameters inside the greenhouse. Therefore, it is important to establish stochastic model to explain the relation between the growth of melon with environmental parameters inside the greenhouse. This paper presents an Artificial Neural Network (ANN) model to predict the growth of melon during vegetative stage of melon in a greenhouse with evaporative cooling in Bogor, Indonesia. Data was collected from October to December 2020 during vegetative stageof melon. The ANN model was developed using six input parameters that are air temperature (^oC), air relative humidity (%), radiometric intensity of sunlight (watt/m^2),plant age (day), leaf area (cm^2), plant height (cm) to predict leaf area (cm^2) and plant height (cm) for the next two days. The results showed that the designed seven hidden nodes-ANN model achieved a high prediction accuracy with R^2 of 0.98 for leaf area validation and plant height validation.

Keywords: ANN model, crop growth, vegetative stage, melon, greenhouse

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P-076. Application of Palm Stearin Edible Coating on CavendishBanana (*Musa acuminata*)

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Abstract. Palm stearin has the potential to alter the use of beeswax. This study aimed to assess the effect of palm stearin as an edible coating on the quality changes of Cavendish banana during storage. The samples of Cavendish banana were stored within eight days with treatment combinations of temperature (room temperature: 28 °C and 10 °C) and application of edible coating (control: without coating, and coated with palm stearin). During the storage period, physicochemicalproperties of the samples were evaluated in terms of weight loss, fruit firmness, total soluble solids,ascorbic acid content, respiration rate, and peel colour. The obtained results showed that storage temperature and storing period significantly ($p< 0.05$) affected the properties of Cavendish banana in terms of weight loss, fruit firmness, CO_2 evolution, and O_2 consumption. Application of palm stearin edible coating significantly affected ($p< 0.05$) weight loss and ascorbic acid content. At roomtemperature, palm stearin edible coating reduced weight loss and maintained ascorbic acid content.On the eighth day of storage, coated samples and controls stored at room temperature lose their weight up to 12.96 % and 23.94 % on average, respectively.

P-077. Design and Simulation of Oil Palm FFB Loading Machine

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Abstract. The process of loading the fresh fruit bunches of oil palm to the truck requires a lotof manpower if it is done manually. In fact, either the palm oil plantation or the smallholder palm oil farmer still performs this task manually, so that it can lead to fatigue and can result ininjuries for the worker due to heavy workload. The purpose of this research is to design and simulate a machine for lifting the fresh fruit bunches to the truck, so that the activities of lifting the fresh fruit bunches to the truck become easier and can have a bigger working capacity. This research was conducted using a functional and structural design approach consisting of severalstages, including: problem identification, design concept formulation, engineering analysis, engineering drawings, material strength analysis, kinematics simulation, power consumption simulation, and digital scale simulation. A simple structure of electric motor-driven bucket elevator was designed to load the fresh fruit bunches on to the truck tailgate. Based on the simulation results, the fresh fruit bunches can be lifted up satisfactorily from the bottom to thetop with an elevator mechanism. This elevator is designed with lightweight for easy installation and kept at the tailgate of the truck. The maximum electric power consumption for lifting the fresh fruit bunches was found to be 1466.24 watts with designed loading capacity 23 ton/hour.

P-078. Mapping and Assessing Black Pepper Growth using Time Series Analysis and Ground Data

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Abstract. Mapping of crop cultivation using remote sensing immensely facilitate crop management and prediction. The capability to provide informative data enables users to monitor and manage their crops with optimum expenditure. Hence, this study was purposed on black pepper farm to establish an informative map of black pepper farm (SF, TF) in Sungai Plan, Bintulu, Sarawak using Landsat 8 OLI time series and ground truth data. Images from Landsat 8 OLI were retrieved and images were classified using Support Vector Machine (SVM). Extraction of farmland elevations was produced using black pepper points collected and processed through ArcGIS 10.4 software. Black pepper growth was measured through the percentage of height and DBH developed throughout this study. The results indicate three levels of land elevation which are lower, middle and upper. Based on the levels show that the percentage of black pepper growth in SF is higher as compared to TF. This study demonstrated that detailed information on geography and black pepper growth can enhance black pepper productivity and management.

Keyword: Crop Mapping, Black Pepper, Landsat 8 OLI, Elevation, Support Vector Machine (SVM)

P-079. Nitrogen Content Detection in Tea Plants using Satellite Image Processing

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ABSTRACT

Tea is a plant whose leaves are harvested, so any determinants of shoot growth will affect production. The purpose of this study was to identify and estimate the nitrogen content of tea leaves using digitalimages from satellites. The method used consists of the data preparation stage where the sample is taken in the form of tea plant leaves to be tested in the laboratory, the data processing stage where data extraction is carried out from thepage Google Earth Engine, the data analysis stage where regression analysis is carried out to find the correlation between nitrogen levels and the value of each channel from the satellite and the last is the creation of a distribution map of the estimated nitrogen content. The research resulted in a model for estimating the nitrogen content of tea plants:N = 2.364 - 9.64 B1 + 8.29 B7 - 2.492 B8 - 20.12 B11 + 29.64 B12 with an R-sq value of 79.67%, R-sq adjusted 74.31% and R-sq predicted by 63.40%. The model has a MAPE value of 3.13%, so the estimator model has an accuracy rate of 96.87%. In the classification of nutrient levels, the overall accuracy is obtained by 60%.

Keywords: Google Earth Engine, mother leaves, Tea.

P-080. Numerical methods and its application in freezing process

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Abstract. Numerical methods is an efficient tool for simulating various processes in the food industry including freezing process. The use of numerical methods such as finite difference, finite element and finite volume analysis to simulate freezing condition in many fruit and vegetable products have produced a large number of models. To achieve a high quality of product, there are critical parameters that have corresponding effects to microstructure need to be consider in numerical modelling. Nevertheless, the accuracy of numerical models can furtherbe improved by more information about the transport phenomena, ice formation and growth, surface heat and mass transfer coefficients, and properties of product, for justifying the acceptability of assumptions in modelling. For further research, it is hoped that this review papercan provide new insights, so that a numerical model could describe not only heat and mass transfer phenomena but also the whole conditions in freezing process and all the critical parameters can be optimized.

P-082. Development of Materials for Vegetable Pesticides on Tropical Plants for Sustainable Agriculture, First Step Research: Identify the Active Ingredients of Several Essential Oils and the Effectiveness of Pesticides on Plants

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Abstract. Sustainable agriculture needs green technology innovation. Vegetable pesticides are an option to replace chemical methods that leave harmful residues. The active ingredients of essential oils can be used to control pests and plant diseases, but need formulations that are suitable for disease control applications in the field, such as liquid form for spraying and paste for coating. This research is part of a preliminary study, conducted to determine the type of active ingredients of 4 essential oils, namely Citronella, Eucalyptus citriodora, E. Globulus and Eucalyptus. Essential oils are formulated in liquid form with turpentine, typol and tween as carriers. In vitro research was conducted on the growth of the fungus Fusarium oxysporumf.sp. vanilla and Phytophthora capsica, as important diseases in vanilla and pepper, respectively. The treatment consisted of 4 essential oils each with concentrations of 100, 200, 300 and 400 ppm, and was repeated 3 times. The results showed that essential oils can inhibit the growth of fungi F. oxysporum and P. capsica with different levels of inhibitors. Citronella oil and E. citriodora can inhibit 100% growth of P. capsica at a concentration of 300 ppm. Meanwhile, at a concentration of 300 ppm, E. globulus and eucalyptus oil only inhibited 61.11% of P. capsica growth. At a concentration of 400 ppm citronella oil and E. citriodora inhibited 100% the growth of F. oxysporum f.sp. vanilla, at the same concentration of E. globulus and eucalyptus inhibited 64.44 and 63.33%, respectively. The results of this study showed that in vitro E. citriodora and citronella oil were more effective in inhibiting the growth of the fungus F.oxysporum f.sp. vanilla and P. capsica. Furthermore, these results will be used to develop a paste form so that its inhibition becomes more effective.

P-083. LoRa-based microclimatic parameter monitoring system for smart greenhouses

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Abstract. Controlled environment plant production system continues to develop as a result of decreasing land availability for open field agriculture and increasing opportunity in using newly developed devices. A well-controlled greenhouse can be used to grow a variety of horticultural crops that have high quality, in good productivity. Several monitoring systems using Bluetooth Low Energy (BLE), Wi-Fi and GSM technologies have been developed to control plant environment inside the greenhouse. However, there are still some limitations of those system. Several drawbacks of BLE technology have been realistically considered, such as communication range limitations and less efficiency in accelerating data transfer. Similarly, Wi-Fi technology also obtains limitations on communication range. Furthermore, the required electrical energy for GSM technology is relatively high. In order to address these problems, LoRa technology is seemingly very suitable to be deployed. This paper introduces a LoRa-based monitoring system for smart greenhouses. There are seven microclimatic parameters monitored by the monitoring system, that are air temperature (°C), air relative humidity (%), light intensity (lux), soilmoisture (%), leaf area (cm^2), and leaf greenness level (0-255). Results show that the monitoring system could read and record microclimatic parameters in real-time, continuously. Furthermore, all microclimatic parameters data has been successfully displayed in form of graphs, tables, images and text. Those data are accessible throughvarious browser engines and operation systems.

Keywords: smart greenhouse, microclimatic parameter, monitoring system, LoRatechnology

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P-084. Estimating the ripeness level of avocado (Persea americana) by using ultraviolet reflection

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Abstract. Avocado (*Persea americana*) is one of popular fruits in Indonesia because of its taste and high antioxidant content. However, research on avocado in Indonesia is still undeveloped. Grading avocados is still undertaken manually by squeezing the fruit to find its hardness to determine the ripeness level while it is already well known that image processing may play an important role in maintaining consistency in grading fruits. This study aims to determine the ripeness level of avocado by using Total Dissolved Solids (TDS), moisture content, and hardness as the parameters, and to determine the correlation between the ultraviolet (UV) reflection and the ripeness level of avocado. The study consists of non-destructive method and destructive method. The first was done by taking pictures/images of avocados surrounded by 4 UV lamps using a Digital Single Lens Reflex (DSLR) camera. There were 120 samples of avocado fruit with 4 levels of ripeness, 30 each, which were obtained from the Puncak area, Bogor. Immediately after completing the picture taking, the destructive method was carried to determine the TDS, moisture content, and hardness of each sample. The lab test results were then used to obtain an equation that estimates the maturity level, expressed in age (days) before ripening, byusing multiple linear regression analysis. The resulted equation is having R-Square of 0.81, which mean that the parameters can be used to determine the ripeness level. The image data wereprocessed further to get the values of Hue (H), Saturation (S) and Intensity (I) at each ripeness level, and from those values their determination coefficient which show the feasibility of the value to represent the ripeness of the avocado were determined. The result shows that the highest determination coefficient was that of I (intensity) of about 0.8191. The results of non-destructiveand destructive method then was correlated each other to show the feasibility of using non- destructive method in estimating the ripeness level of avocado. The result shows that the usage of UV reflection, especially the value of intensity, for determining the ripeness level of avocadois feasible.

Keyword: Avocado, ripeness level, image processing, UV

P-086. Postural analysis in design evaluation of oil palm loose fruits collector machine

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Abstract. The level of maturity and the harvesting process for oil palm bunches allows some fruit to be detached from the bunch. Fruit that is separated from the bunch is called loose fruit. The loose fruit must be collected to reduce post-harvest losses. The ERBRON-C machine has been designed to facilitate the process of picking loose fruit, but further study is needed regarding its working system as an interaction between the machine and its operator. This study aimed to determine the level of risk of working posture in loose fruit collection using ERBRON-C. This research was conducted by collecting anthropometric data, recording the subject's posture, evaluating posture using the REBA method. The results of the posture evaluation showed REBA scores ranged from 2 to 5 which refers to a low to moderate risk level.

P-087. Techno Economic Analysis of Shallot Planting Material Production From TSS (True Shallot Seed) with LCAC (Low CostAerophonic Chamber) Technology

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ABSTRACT

The decline in the productivity of shallots occurred in almost all areas of shallot production centers in Indonesia. One of the factors in the decline in productivity isthat farmers are still dependent on tuber seeds that are produced by themselves fromgeneration to generation without any risk of carrying degenerative diseases from previous shallots. Another problem is that the cost of providing seeds is quite high,reaching 40% of the total production cost, with an average requirement of 1-1.5 tons/hectare. Planting shallots using TSS (True Shallot Seed) is an alternative solution, in terms of seed requirements, only 3-5 kg/ha is needed. However, an initial activity is needed in the form of the production of shallot planting material before it is transferred to the land. This study aims to conduct a technoeconomic analysis of shallot planting material production from TSS with LCAC (Low Cost Aerophonic Chamber) technology. Technoeconomic analysis is carried out by calculating the basic costs for producing shallot seeds, and economic analysis related to NPV, IRR and BC Ratio. The results of the analysis show that the basic cost of producing seeds from TSS is 80.8 IDR/seed, IRR 36.9%, and Net BC Ratio 1.41 , with business scale one million seeds per cycle. At the same selling price level, the 500 trays business scale has an IRR of 11.3% with a Net BC Ratio of 1.03with 2 years of observation.

Keywords: Techno economics, True Shallot Seed, Low cost, Aero phonic Chamber

P-089. Mapping of Soil EC in Relation with Selected Chemical Properties of Soil

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Abstract. Mapping the physical and chemical properties of the soil is an important factor in the process of land preparation and basic fertilization. Knowing the physical and chemical properties, the soil can be treated according to the conditions and needs of the soil. The main purpose is to make sure that soil have good nutrients for plant growth. However, soil has different physical and chemical properties in each soil condition. This is certainly a factor that needs to be considered because it needs a high enough accuracy because this affects the productivity of plant growth in real-time. Today the determination of physical and chemical properties of soil can be done using the probe method where an instrument is inserted into the soil and the instrument will display the measurement results. Veris 3100 is an instrument that can measure the conductivity of soil resistance (EC), EC will be measured in real time. The resistivity of the soil is also a property of the soil. This study aims to see the relation between soil conductivity with physical and chemical properties of the soil as an estimate of soil fertility before tillage.

P-090. Quality Development Study of Pineapple (Ananas comosus L. Merr) during Controlled Atmosphere Storage in Low Temperature

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Abstract. Pineapple (Ananas comosus [Linnaeus] Merrill) is one of the leading tropical fruit commodities in Indonesia. One of the characteristics of tropical fruit is its perishability and short shelf life. To maintain quality, especially in storage and transportation, it is necessary to inhibit respiration rate. In this study, pineapple fruit was stored under controlled atmospheric conditions (CAS). The condition of the CAS room was controlled by the criteria, air temperature ±10°C, RH > 80 %, and oxygen concentration 5.5 % - 7%. During storage, pineapple fruit quality was evaluated, including weight loss (%), total dissolved solids (% Brix), total titrated acid (%), Fruit texture/hardness (N), visual appearance, and changes in the color of the flesh. As a control, pineapple fruit was stored in a refrigerator with a temperature of 10°C and a measured humidity of ±25%. Each observation was carried out 7 replications at the end of each batch (batch 1: 7 days, batch 2: 14 days, batch 3: 21 days, batch 4: 28 days, and batch 5: 35 days). The results showed that pineapples stored in CAS conditions experienced a weight loss rate of 0.95%/week, much lower than the control, which was 3.69%/week. However, for the value of total soluble solids, total titrated acid, and changes in flesh color, there was no significant difference between pineapples in CAS and controls.

P-091. Design and Performance Test of Low Cost Aerophonic Chamber (LCAC) using Ultrasonic Atomizer for Shallot Seedling from TrueShallot Seed (TSS)

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Abstract. Various doubts about the true shallot seed (TSS) are still growing in the community,due to the farmers' habit of using shallots bulbs for the production. One of the obstacles faced was seedling process that not easy for Indonesian farmers. Shallot cultivation using TSS with conventional seedling results in a fairly low percentageof seeding success. Thus, a TSS seedling technology is needed in a controlled environment. The objective of this research was designed an aeroponic chamber asa medium and a place to grow TSS seeds into shallot seeds that are ready to be transferred to land with a high success rate and relatively short time compared to conventional seeding. The aeroponic water irrigation uses ultrasonic atomization (UA) technology to break down nutrient molecules in the chamber into mist. This can reduce the consumption of electrical energy compared to utilizing a high- pressure nutrient pump. The test results show that UA can atomize nutrients in therange of values of 0-500 ppm with a suitability level of 98.63%. TSS seedling rateabout 80-90 % for Maserati variety. The total energy consumption per seedling time for 40 days is about 3.21 watts/plant.

Keywords: Aeroponic , Ultrasonic Atomizer, Seedling, True Shallot Seed

P-092. Analysis of Farm Machinery Requirements Based on Human Labor Productivity in Rice Cultivation - A case study in Sumenep District

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Abstract. The objective of this study is to predict the need for farm machinery in rice cultivation, based on the productivity of manpower available in Sumenep Regency. The fluctuations in the availability of manpower, the cycle of rice cultivation which is influenced by the seasons as well as the type of equipment used today and the possibility in the future are also taken into account. The requirements for farm machinery when the availability of manpower is maximum are as follows, 797 units of two-wheel tractors, 1,174 units of power weeder, and 96 units of combine harvester. Meanwhile, when the availability of manpower is minimum, it is require, 875 units oftwo-wheel tractors, 1,414 units of power weeder, 90 units of knapsack power duster, 678 hand sprayers, and 187 combined harvesters. The energy productivity of human labor in three conditions of labor availability is as follows: 0.0168 kg DUR/kcal on actual conditions, 0.0371 kg DUR/kcal on maximum labor availability and 0.1151 DUR/kcal on minimum labor availability.

Keyword: energy productivity, agricultural machinery, rice.

P-093. Design and performance analysis of crude biodiesel reactor and high pressure stove using recycling palm oil for small and mediumenterprise in bogor, Indonesia

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Abstract. According to partners, waste cooking oil is often discarded and the environment. sometimes he used cooking oil as fuel for homemade stoves to boil skins before being cut into pieces, but the resulting fire is large and can be physically hurt. In addition, according to the stove partners, it tends to be unstable and can explode at any time. In one production, the gas used can be reached 7 green tubes of LPG, which is about 21 kg gas. this will certainly increase production costs and there are availability constraints in the market (sometimes out of stock), thus disrupting the production process. Efforts to utilize waste cooking oil as a complementary energy source in addition to gas in SMEs, by designing crude biodiesel reactors (crude) and high-pressure biodiesel stoves. Cylindrical reactor with stainless steel material. The reactor is 30 cm in diameter and 50 cm high. copper hose with a diameter of 4 mm and a length of 200 cm. Furnaces with cast iron or steel. The furnace is 20 cm in diameter and 2 cm high. The oil tube is 25 cm in diameter and 30 cm high. Thewast cooking oil will enter the reactor and there is a process of making biodiesel with catalyst transesterification in the form of 3.735 L methanol 0.202 g KOH for 15 L waste cooking oil, after that the reactor will rotate and be heated at a temperature of 65 C for 1 hour. After the biodiesel reaction is complete, let it sit for 15-30 minutes to separate it from the glycerol. So that it produces 3.984 kg of glycerol which will be accommodated in the bottom container and 11.05 kg of biodieselcrud which will be flowed into the oil tube, after that the oil tube is pumped so that pressure occurstowards the furnace, the furnace is heated with low flame combustion, the oil will undergo a phase change to gas. so that the stove will burn with biodiesel fuel.

P-096. Performance Comparison of the Implementations of Single Row Power Weeder (*Single Engine*)and Multi-Row Power Weeder (*Twin-Engine*) in Rice Fields

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Abstract. Weeding rice weeds is done to reduce and prevent the competition of nutrients absorption between weeds/grass and rice plants. Weed control can be applied through various techniques, including pulling and piling the weeds into the soil. Weeds buried in the soil can be decomposed and become nutrients for rice plants. One application of technology used in weeding weeds is the use of single row power weeder (*single engine*) and multi-row power weeder (*twin-engine*). The research aimed to compare the performance in using a single row power weeder (*single engine*) and multi-row power weeder (*twin- engine*) in rice fields. The multi-row power weeder was designed by combining a single row power weeder. This research was conducted by testing the performance of the power weeder in rice fields in an area of 14 m x 4 m for each replication. The total area of land used was 560 m^2 with five experimental replicates. Weeding activities were carried out on rice plants aged 30 DAP. The results showed a successive comparison between the performance of the single row power weeder (*single engine*) and the multi-row power weeder (*twin-engine*), such as the theoretical working capacity was 0.037 ha/hour and 0.054 ha/hour, effective working capacity was 11.11 minutes and 9.78 minutes, the efficiency of the weeder performance was 82.48% and 64.87%, fuel consumption was 1.07 liters/hour and 1.92 liters/hour, and the success rate of weeding was 64.41 % and 59.77 %. The calculation results of the plant damage levels were 15 plants and 31 plants, while the mudding index values were 75.26% and 77.62%. The results of this study showed that the advantages of using a single row power weeder were on the parameters of effective working capacity, weeding efficiency, fuel, weeding success, and low plant damage. The advantages of the multi-row power weeder were the parameters of theoretical working capacity, effective working capacity, and muddling index.

Keywords: A Single Row Power Weeder, Multi-Row Power Weeder, Rice Plants, Weeder Performance.

P-098. IN THE ALOR DISTRICT, EAST NUSA TENGGARA PROVINCE, A STUDY OF MAPPING THE POTENTIAL OFSEAWEED MARKET AND MARKET CHAIN

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Abstract. Seaweed is a significant economic product that should be promoted. A transparent trading system, which is intended to support the growth and development of seaweed production on a greater scale, is one of the main criteria for providing stronger value to cultivators. This is a benefit that the Indonesian people, in general, can takeadvantage of to their fullest potential. In June 2021, a survey will be conducted in Alor Regency, Nusa Tenggara Timur Province, to map market potential and market chains. Seaweed farmers and traders interested in seaweedmarketing made up the study's population. The sampling method used the snowball sampling method, namely the first level sampling, in this case, was seaweed farmers determined by simple random sampling, while the nextsample, in this case, was traders determined by farmers where farmer s who had selected are identified (excavated data). The goal of doing a market chain research and business strategy for seaweed commodities is to have a more complete picture of the potential, obstacles, and restrictions of developing seaweed production in the Alor Regency.Based on observations and interviews with farmers, it appears that the seaweed marketing chain begins withproducers as seaweed farmers, followed by middleman traders (village collectors), i. e. traders who buy directly fromvillage farmers. Also, there are inter-island collectors/collectors (PAP), who are traders who purchase seaweed from middlemen/seaweed collector traders and also farmers, most of whom are based in Alor, the sub-district capital.Collector traders have a great deal of money, so they can keep seaweed temporarily as they wait for a reasonableprice or a better price.

Keywords: Seaweed, Marketing Chain, Alor.

P-099. Preliminary study: the addition of konjac glucomannan-basedhydrogel into chocolate increases the melting point of chocolate

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Abstract. Chocolate easily melts at a temperature of 32-34ºC. This is a challenge for tropical countries, such as Indonesia. To cope with this problem, an innovation is needed to produce a heat-resistant chocolate. One of methods that can be done is by adding hydrogel. The purpose of this research was to investigate the effect of hydrogel made from konjac glucomannan on the physical characteristics of chocolate. In this study, hydrogel with a proportion of 2% was added into chocolate at the end of conching process. The influence of three different hydrogels made with konjac glucomannan concentration of 3%, 5%, and 7% was investigated. The result showed that the addition of hydrogel had a significant effect on the characteristics of chocolate. The addition of hydrogel did not only increase the melting point of chocolate, but also increased thehardness and particle size of chocolate. The higher the hydrogel concentration, the higher the melting point and hardness values. In conclusion, the addition of konjac glucomannan-based hydrogel in chocolate has the potential to produce a heat-resistant chocolate.

P-100. Cultivation Technology for Drought Stress Mitigation in Tea Plants

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Abstract. The tea plant as one of the beverage plants has a high value of economic and opportunities to increase its production. The tea plant requires an air temperature of around 22^{o}C so that the increase in temperature due to global warming greatly affects its growth and productivity. Global warming is followed by climate change, resulting in prolonged droughts (for more than three consecutive months), and changes in rainfall patterns. The airtemperature has increased, over the last 100 years, the air temperature on the earth's surfacehas increased by an average of 0.74^{0}C. Tea plants can suffer from temporary wilting, chronic wilting, leafs falling, dry shoots and young branches, and dead branches, old twigs,huge branches, stems as a result of prolonged dryness. Drought caused damage to tea plants, resulting in a 53 percent fall in yield. To overcome this, cultivation technology can be usedin the following ways: (1) tolerant variety, (2) fertilization, (3) mulching and planting shade trees, (3) pruning, and (4) manufacture of silt pits and irrigation canals.

Key words: Camellia sinensis, climate change, rainfall, growth, productivity

P-101. Hydropic Rice Nursery for Rice Transplating Using Rice Transplanters

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Rice nursery using dapogs requires a series of media preparation activities involvingsieving the soil, mixing with organic fertilizer and rice husk charcoal, which is . One otherpractical method to grow the rice seedling is applying hidroponic system. The purpose ofthis research was to develop a hydroponic system to grow rice seedling until it is ready for tranplanting with rice tranplanters.The seedling nursery were designed having of a 10level rack with several trays on each level. designed using a tray placed on a multilevel nursery rack with the installation of the DFT, NFT and puddle hydroponic systems. Nutrient solutions use concentration rate of 2.2 mS, 2.4 mS and 2.6 mS and use seed density levels of 3 seeds/cm2, 4 seeds/cm2, and 5 seeds/cm2. The results showed that the DFT, NFT, and puddle hydroponic systems produced plant height that was not significantly different where an average of 17.06 cm. Nutrient concentration with EC of 2.2 mS, EC 2.4 mS, and 2.6 mS did not significantly affect plant height with an average of 17.37 cm. The level of density of 3 seeds/cm2, 4 seeds/cm2, 5 seeds/cm2 did not significantly affect plant height with an average of 17.35 cm. Light illumination at rack level1-6 is significantly different from level 7 (the top shelf) is at level 3. Measurement effectiveness of planting at less level of 90 planting holes and the effectiveness of plantingmiddle level as many as 90 planting holes. The effectiveness of the planting is the percentage of upright seedlings, fallen seedlings and seedlings are not embedded at theless level of 90 consecutive planting holes are 88.64%, 8.26% and 3.10% and in the middle level planting as much as 90 consecutive planting holes are 91.29%, 5.52% dan 2.61%. The number of seedlings that are embedded at less and middle levels varies, namely in the range of 3-8 seedlings per clump for the less level and in therange of 4-12 seedlings per clump for the middle level. Further research is neededon (1) the design of a nursery rack device that has additional lighting and (3) thedesign of a planting fork that can cut the roots of the seedlings so that only seedling inside the fork will be planted by the planting fork.

P-102. Yield Qualities Evaluation for Gayo Arabica Coffee Germplasm

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Gayo Arabica coffee has been known in the world market as specialty coffee. Some lines of Arabica coffee that have been planted in the Gayo Experimental Station (GES) for more than 20 years have the potential to be released as superior varieties. This study aimed to evaluate the physical, physicochemical and organoleptic qualities of 15 Arabica coffee lines in the GES germplasm. The physical quality test of beans refers to SNI 2907-2008 by observing the length, width, thickness, and weight of 100 beans. Physicochemical content testing was carried out on beans, including caffeine, protein, fat, and ash. Organoleptic testing was carried out by certified panelists referring to the Specialty Coffee Association of America (SCAA) standards. The evaluation results of 15 Gayo Arabica coffee lines showed that all lines had the good physical quality of beans. Protein content ranges from 10.79-14.14%, caffeine 0.51-0.82, and fat 12.48-15.68%. All tested Arabica coffees had a total score of more than 80, which means they are included in the specialty category. The Ateng Super, C 49, and SLN 9 lines had a better taste (85.75) than the superior varieties released, namely Gayo 1 (83.75) and Gayo 2 (85.50).

Keyword: Specialty, physical, physicochemical, organoleptic

P-103. Detection and Classification of Basal Stem Rot Disease on Oil Palm Seedlings using Electronic Nose

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Abstract. Basal Stem Rot (BSR) is one of plant diseases that has baffled oil palm industry for decades due to its fast widespread. Efficient early detection methods have been proposed including using an electronic nose due to the volatile compounds released by Ganoderma fungi during infection. This study aimed to use a portable, cost effective electronic nose to detect and classify 60 oil palm seedlings which were previously inoculated by Ganoderma isolates at 4 months of age. The samples were divided by 4 groups consisted of 15 seedlings. Three groups were inoculated on their roots with different time in one-week interval which were labeled as A, B, C, the other samples were classified as D with no inoculation. The testing was carried out on the inoculated plant roots, stems, and leaves. Boninense sp after the seedlings were let grown under a controlled condition in 6-month period. The electronic nose system built consisted of 6 TGS gas sensors, interfacing circuit, Python based program. Principal Component Analysis (PCA) was used to group the seedlings based on the detected signal from the electronic nose. A neural network model was also developed to classify the seedlings based on the duration of treatment. The PCA results higher cumulative variance on sensor response when the electronic nose used on plant leaves. Three TGS sensor show higher response which are TGS 2611. TGS2612 and TGS2610. ANN analysis shows that the electronic nose is able to classify the seedlings based on the different groups.

P-104. Application of multispectral UAV for paddy growth monitoring in Jitra, Kedah, Malaysia

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Abstract. Rice is the staple food for most people in Southeast Asia, mainly Malaysia. Unfortunately, Malaysia does not reach a 100% self-sufficiency level on rice production due to inefficiency of rice farm management, pest and disease outbreak, poorly irrigation system, and climate change. Each spectral band of electromagnetic signature in the rice crops can be identified to analyse the crop condition from the reflectance value. Therefore, UAV can capture different spectral band images of the rice field depending on the sensors used. This study aims to produce a paddy growth map based on the normalized difference vegetative index (NDVI) value and validate the paddy growth map using the soil plant analysis development (SPAD) data. This study was carried out at the paddy field planted with PadiU Putra rice variety in Muda Agricultural Development Authority (MADA), Jitra in Kedah. Three reading samples for each point at the paddy field within 1 m radius were recorded. Then, the samples from each point were scanned using SPAD chlorophyll meter. The image data were collected using multispectral and RGB cameras at the altitude of 60m, and a calibrated reflectance panel was used to calibrate the image. Ground control point (GCP) was placed at the four corners of the study plot, and it was being used as a georeferencing point for aerial imagery mapping. Those images were undergone orthomosaic process to produce a single overlapped image using ArcGIS software. NDVI was used to measure the healthy level of rice crops. NDVI map had shown the distribution of NDVI value across the study plot, which includes the healthy and less healthy vegetative area. SPAD value has no significant relationship with the aerial imagery of NDVI value in this study. The NDVI map allows the farmers to monitor the paddy growth status and effectively improve their rice farm management. In the future, advanced classification methods based on the reflectance of weed, water and soil can be prioritized and separated into different classes, whereby the NDVI map can be plotted on the paddy crops.

Keyword: Multispectral, Normalized Difference Vegetative Index, Paddy Growth, Unmanned Aerial Vehicle

P-106. Comparison of engine performance and emissions for diesel-biodiesel fuel blend and biodiesel

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Abstract. Biodiesel is a substitute or replacement petroleum diesel fuel used to reduce pollution without modifying engines. The aims of this study experimentally investigate engine performance and emissions characteristics of passenger car engine (Hillux 2.4G Double cabin (4x4) M/T) engine fuelled by two different fuels, which is biodiesel (B100) and diesel-biodiesel fuel blend (B20). The result showed that the traction and power for diesel-biodiesel fuel blends were obtained slightly higher than biodiesel. Biodiesel has marginally higher fuel consumption in fuel consumption than diesel-biodiesel fuel blends. According to the emission analysis, biodiesel produces lower exhaust emissions of unburned fuel emissions, carbon monoxide, and carbon dioxide content in the exhaust gas than diesel fuels.

Keywords: traction, performance, exhaust

P-107. Cultivation Technology to Mitigate Drought Stress in Tea Plants

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Abstract. The tea plant as one of the beverage plants has a high value of economic and opportunities to increase its production. The tea plant requires an air temperature of around 220C so that the increase in temperature due to global warming greatly affects its growth and productivity. Global warming is followed by climate change, resulting in prolonged droughts (for more than three consecutive months), and changes in rainfall patterns. The air temperature has increased, over the last 100 years, the air temperature on the earth's surface has increased by an average of 0.740C. Tea plants can suffer from temporary wilting, chronic wilting, leafs falling, dry shoots and young branches, and dead branches, old twigs, huge branches, stems as a result of prolonged dryness. Drought caused damage to tea plants, resulting in a 53 percent fall in yield. To overcome this, cultivation technology can be used in the following ways: (1) tolerant variety, (2) fertilization, (3) mulching and planting shade trees, (3) pruning, and (4) manufacture of ditch and irrigation canals.

Key words: Camellia sinensis, climate change, rainfall, growth, productivity

P-108. Detemine Field and Machine Operating Condition of Rice Combine Harvester to Minimize Grain Loss

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Abstract. Paddy can be harvested by manual or a machine called rice combine harvester. Farmers espect to do their harvesting with high efficiency with minimum losses because of time and cost. Unfortunately traditional farmers are lacking of knowledge and information required for selecting suitable combine harvesters and how to provide proper field condition for the machine operation.. The objective of this research to do analysis on operating condition of field and harvesting machine during harvesting operations. The study was conducted in mechanized rice field belongs to Mechanization Research and Development Center at Cihea, Cianjur, Jawa Barat. Scope of this study include observation on field operating condition and machine performance of each unit/component during harvesting. The results showed that the field condition during harvesting operation indicated by dry bulk density, penetration resistance, porosity, and moisture content was 0.9 g/cc, 5.55 kgf/cm2 65.49 % and 72,52 % respectively. Slip was 8,01 % with actual velocity of 0,535 m/s. Field efficiency of the machine was 77,12 %. Traction evaluation showed that rolling resistance was 121,6 kg from total weight, and critical traction of 532 kg with rimpull value of 1525,15 kg. Harvesting capacity of 915,28 kg/h. During harvesting, it was found that grain loss was 2,07 %. The capacity of hay disposal unit was 170.64 kg/h with 97.69 % of grain cleanliness level. Fuel consumption was 1,02 liter/h. According to SNI 8185-2015, the rice combine harvester was properly operated in optimum field condition indicated by field efficiency and machine operating condition indicated by the performance of machine units.

Keywords: Combine harvester, operation condition, grain loss.

P-109. Characteristics of Oil Palm Stem Mulch as Soil Conditioner at Oil Palm Replanting Area

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Abstract. Oil palm is a plantation crop that has great potential in Indonesia. The very rapid development of oil palm is due to the high economic value of this commodity. However, the handling and utilization of oil palm waste resulting from replanting is not optimal yet. Planting new seedlings is delayed because the decomposition process of oil palm stems from replanting takes a long time. One method of replanting uses a mulcher machine which produces mulches in the form of thin fibers and has different characteristics from other replanting methods. The purpose of this study was to identify the characteristics of the mulch from the chopping of oil palm stems using a mulcher, to learn the effect of oil palm stem mulch on soil conditioner in oil palm replanting land, and to determine the optimum heap thickness to maintain soil quality in oil palm replanting land. Oil palm stem mulch was composted for two months using the bin method. The application of oil palm stem mulch as a soil conditioner was carried out in different thickness treatment was 1 cm, 5 cm, 10 cm thickness and control. Oil palm stem compost chopped by mulcher has the characteristics as the quality of standard Indonesian compost and decomposed faster than other replanting methods. The results showed that at a soil depth of 0-5 cm, 5-10 cm, 10-15 cm and 15-20 cm, mulch with a thickness of 10 cm was the best treatment because it was able to increase the average value of soil moisture content respectively amounted to 28,22% and decreased the value of soil penetration resistance and soil temperature to 15,13 kgf /cm^2 and 27,5 ^oC respectively. The results was in the compost criteria of SNI:19-7030-2004, which is moisture content of 22,99%; density of mulch of 0,77 g/cm^3; C-organic content of 10,72%; N-total of 0,7952%; mulch porosity of 70,3%; and C/N ratio of 13,48%.

Keywords: composting, oil palm stem, mulch, soil conditioner

P-110. An Automated Gantry-Robot Painting System Design and Development Process

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Abstract. The design process of spray paint booths needs to be carefully designed to minimize health, safety and environmental risks. Proposed Automated Gantry Robot Painting (AGRP) System specification planning was conducted with competitive assessment and analysis for engineering characteristics after identifying the customer requirements. A robotic painting system can improve the operator safety and health from polluted air and volatile organic compounds (VOCs) exposed to the operator during the painting process. Integrating a robotic system inside a painting booth can increased painting area, increase productivity, and improve finish quality products. In this research, we concentrate to come out with the idea to develop a painting robot with less expensive, more accurate, and more reliable than a manual painting system. The was discussed and shown that implementing this system will enhance productivity up to 67.8% from over all the current manual painting systems and improve product quality. This AGRP system can ensure a safe working environment, more productive, and ergonomic workplace and process.

P-111. Analysis on the Effect of Metal Inert Gas Welding Current and Travel Speed on the Mechanical Properties of Mild Steel Weld Joints

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Abstract. This research investigates the effect of welding current and travel speed on the mechanical properties of the welded Mild Steel rod with a carbon content of 0.15% using the Metal Inert Gas Welding. By varying the welding current and travel speed and a constant welding gap of 3 mm, each specimen is then pulled using the Instron Universal Testing Machine. The maximum tensile strength value from each travel speed is recorded and compared. The result shows that the tensile strength increased as the welding current increased until it reached an optimum value.

P.112. Machine Learning Method in Detecting a distributed of service (DDoS): A Systematic Literature Review

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Abstract. This paper presents the systematic literature review of application machine learning method in detecting a distributed of service (DDoS) attack. From the literature several relevant research papers were selected and they were reviewed based on method using to provide the best performances and evidences in machine learning technique applications. The researchers are dedicating their efforts to analyzing, summarizing, and evaluating various machine learning methods for detecting DDoS attacks. Therefore, the purpose of this study is to evaluate several machine learning approaches for detecting DDoS attacks in computer networks. These mechanisms are characterized into five categories, the Multiple Linear Regression method, Deep Neural Network (DNN) and Long Short-Term Memory (LSTM) method, Recurrent Neural Network (RNN) with Autoencoder, Deep learning-based method, and LSTM with Singular Value Decomposition (SVD). The paper also discusses and debates several open research questions and the research technique, parameters, and metrics. Also reviewed and contrasted were summaries of analyses and gaps in deploying a predictable machine learning model. Thus, the paper is expected to benefit academicians and researchers in developing an efficient solution for the machine learning mentioned above in detecting DDoS attacks.

Keywords: Cybersecurity, Network security, Machine learning Deep Learning, Distributed denial of service (DDOS), Recurrent neural network (RNN), Long short-term memory (LSTM), Deep Neural Network (DNN), Singular Value Decomposition (SVD)

P.113. Experimental and Analyzing the Effect of Machining Parameters to the Surface Roughness of Aluminium

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Abstract. Surface finish is the term to describe the surface of the materials, which is defined as the measure of the overall texture of the surface that includes roughness, waviness, and lay. The surface finish of the manufactured products may vary depending on the materials and processes used during the production of the product. In this project, Aluminium rod will undergo turning operation by varying the feed, speed and depth of cut to determine the best setting to obtain a better surface finish. Tungsten carbide is used as the cutting tool where the process will be carried on without coolant. There is various limitation during the experiment is conducted which lead to insufficient data to be compared. From the conducted experiment, the most significant parameters are the spindle speed and the feed rate. Furthermore, the best parameter obtained is when the spindle speed is at 2000rpm with a feed rate of 0.28mm/rev and depth of cut of 0.2mm.

Keywords: Feed rate, Spindle speed, Depth of cutting, Surface roughness

P.114. Cultivation Technology to Mitigate Drought Stress in Tea Plants

P.115. Characterization of The Yield and Quality of Patchouli Oil Based on The Size of Chopping and Drying Type

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Abstract. One of the factors that affect the low yield and quality of patchouli oil is the way of handling raw materials. The purpose of this study was to examine the effect of drying type and chopping size on the yield and quality of patchouli oil. The method used in this research was experimental with descriptive analysis using two factors, namely the chopping size and the drying type. The results showed that the difference in the size of the chopped and the type of drying had a significant effect on the yield of patchouli oil, while the quality had an effect and no effect. Based on the analysis of the yield and quality of patchouli oil, the best treatment obtained in this study was the condition of chopping size 7 cm followed by drying (R_1P_1). The yield value of patchouli oil obtained in the R_1P_1 treatment is the highest yield of 2.55 % with yellow oil, specific gravity 0.973 g/g, solubility in alcohol 1:1, ester number 8.48 ml/g, refractive index 1.508^o, patchouli alcohol 31.31 % are in accordance with SNI standards while the optical rotation -44.50^o, and the acid number of 23.9 ml/g are not according to the SNI standard.

For domestic participants

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Tips Sebelum Presentasi dalam Bahasa Inggris

Get Yourself Prepared. Yang paling penting sebelum presentasi adalah persiapan. Apa saja yang perlu disiapkan?

Yang **pertama** adalah bahan presentasi. Ibarat sebelum berperang, kita harus siapkan dulu amunisi dan senjatanya. Materi apa yang akan kamu presentasikan? pastikan materi sudah dipersiapkan dengan baik. Jika kamu akan menyampaikan materi tentang cara menanam hidroponik, maka kumpulkan materi tentang hidroponik, kuasai materinya, lalu buat powerpointnya. Namun, sebelum kamu membuat powerpoint, ada baiknya untuk membuat dua hal ini: mindmap dan atau essay. Mindmap bertujuan untuk mempermudah kita dalam mengingat materi presentasi, sedangkan essay berfungsi untuk mempertajam materi karena di dalam essay, tentunya materi sudah sangat lengkap, hanya tinggal mengkonversi essay menjadi powerpoint. Jangan lupa untuk membuat mindmap dan essay juga dalam bahasa inggri agar lebih mudah saat pembuatan, dan kamu bisa lebih menguasai vocab terkait karena sudah sering menemuinya. Hal penting dalam membuat powerpoint, yaitu upayakan membuat PPT yang menarik. Untuk itu kamu harus bisa mengukur pilihan warna, font, dan design template yang pas untuk disajikan.

Persiapan yang **kedua,** yaitu berlatih. Apalagi jika kamu presentasi dalam bahasa inggris. Ada vocab yang harus kamu kuasai terkait dengan materi presentasi. misalnya, kamu akan presentasi tentang perkapalan. Maka vocab tentang kapal, laut, dan sebagainya harus sudah ada di kepala kamu. Selain itu, tata bahasa yang baik dan formal juga dibutuhkan dalam presentasi. Berlatih sebelum presentasi juga bisa meningkatkan self-confidence atau rasa percaya diri.

Persiapan **ketiga** adalah penampilan sebelum presentasi. Pastikan kamu memberikan penampilan terbaik saat presentasi. Tidur dan makan yang cukup agar tubuh tampak fit, dan siapkan pakaian terbaik saat presentasi agar kita tampil menarik dan audiens tidak bosan saat melihat kita tampil. Jangan sampai para penonton kabur gara-gara penampilan kita yang amburadul ya hehehe

Saat Presentasi Berlangsung

Saat presentasi, what should you do? Tentu saja DO THE BEST. Lakukan yang terbaik yang kamu bisa. Namun sebelum itu, apakah kamu sudah membuat struktur presentasi? Kalau belum, mari kita buat list of rundown presentasi yang baik. Paling tidak, beberapa poin ini harus ada dalam presentasi kamu:

1. Greetings (ucapan pembuka)

- *Good Morning, Ladies and Gentlemen. I would like to say thank you for coming in my presentation. It's great to see you all. My name is ....*
- *Assalamu'alaikum Wr. Wb . Thank you for coming to this presentation. I am glad to see you all.*
- *Good morning . Afternoon ladies and gentlemen. an honor to meet you here.*

PS: jangan lupa untuk senyum yaaa ^_^

2. Introducing the Presenter(s) (perkenalan diri)

- *Let me introduce myself and my partner, I am .... and my partner is ..... . We are from ....*
- *Let us introduce ourselves. I'm ..... next to me is ..... The lady in purple is ....*
- *Let me introduce myself. My name's ..... Iam from...*

3. State the Focus of the Topic (maksud dan tujuan presentasi)

- *In this opportunity, I would like to present .....*
- *The purpose of my presentation is ....*
- *In this presentation, we will discuss about .....*

4. Share the Main Content of Presentation (sampaikan materi)

- Gunakan transisi: *First, I will explain to you about ..... Then, I will explain why ..... is so important for us. Finally, you will know how to .....*
- Gunakan kata-kata yang menunjukkan reason, contrast, or result: *because ....., since ....., but, however, although, in addition, therefore, consequently.*
- Gunakan contoh: *the examples are ....., the only example of this species is ....., We will see how many examples we will show you but look at the pictures first.*

PS: sesi ini adalah inti dari presentasi kamu, sedangkan sesi lainnya merupakan pendukung untuk suksesnya sesi inti ini. So, pastikan beberapa hal saat menyampaikan isi materi yaitu: sampaikan secara meyakinkan, tidak bicara terburu-buru, mengatur nafas dan mengatur nada bicara, kamu juga bisa improvisasi jika ada audiens yang mengantuk, melakukan eye contact dengan audiens, dan kamu bisa menyiapkan catatan kecil jika perlu.

5. Question and Answer (tanya jawab)

- *Anybody would like to ask?*
- *There will be qusetion and answer in this presentation*
- *Just feel free to interrupt me if you have something to ask*
- *You can freely ask question about this presentation*
- *I will try to answer any questions you may have*

PS: Jangan lupa untuk memoderatori tanya jawab. Misalnya, pertanyaan hanya dibatasi untuk sekian orang, lalu lihat waktu untuk tanya jawab ini jangan sampai "kebablasan"

6. Make a Summary (kesimpulan)

- *In conclusion ....*
- *In summary ....*
- *So the points are ....*
- *In short ....*
- *To summarize ....*
- *To sum up ....*
- *To conclude ....*

7. Closing (salam penutup)

- Thank you very much for your great attention, ladies and gentlemen.
- Thank you for your attention.
- Thank you for listening. May all those we have shares be benificial for all of us.

Contoh pembukaan dan penutup diskusi dalam bahasa inggris.

Opening:

"Good morning/evening ladies and gentlemen,

today we are going to discuss about (judul atau tema diskusi). But firstly I would like to introduce my team (atau nama pembicara) who will speak in this occasion. Right from my left/right hand (menunjukkan), Mr./Mrs./Ms. (nama), dan seterusnya...

Closing:

From our discussion, I/we (tergantung siapa yang mau menyimpulkan) can conclude that (kesimpulan diskusi). So that, we should/must do...(saran). Thank you very much for your participation. Good bye!

PS: Pada sesi akhir ini, sampaikan ucapan terima kasih kepada penonton, berikan kesan akhir yang baik dan meyakinkan bahwa presentasi kamu sukses. Jangan lupa senyumnya ^_^

Cara Memulai Presentasi dalam Bahasa Inggris 1

Yang pertama, kita akan membahas tentang membuka suatu presentasi secara tradisional atau cara yang baku. Urutan hal yang dilakukan untuk membuka presentasi dengan cara ini terdiri dari dua babak sebagai berikut:

a) *Introducing yourself* (Memperkenalkan diri)

Pembukaan yang kita haturkan berisikan *greetings, name, and position*—alias salam, perkenalan nama dan jabatan atau status. Perkenalan ini menunjukkan siapa kita dalam membawakan materi yang akan dipresentasikan; apakah perwakilan dari suatu perusahaan atau karyawan sebuah instansi.

Polanya adalah sebagai berikut:

- *Good morning. My name is …, and I'm a … at …* (Selamat pagi. Nama saya …, dan saya adalah … di perusahaan/instansi …)
- *Good afternoon, everyone. Let me tell you a bit about myself. My name's … I'm … at …* (Selamat siang, semuanya. Izinkan saya menceritakan sedikit tentang diri saya. Nama saya …, saya adalah … di perusahaan/instansi…)
- etc

b) *Introducing your talk* (Membacakan pengantar)

Setelah memperkenalkan diri, lanjutkan pembukaan dengan membahas garis besar presentasi yang akan dibawakan. Adapun rangkaiannya adalah sebagai berikut:

- ***Subject*** **(Subyek/Topik Presentasi)**
  - *I'd like to talk to you today about…* (Saya akan membahas tentang…)

    - *The subject of my presentation is…* (Subyek presentasi saya adalah…)
    - *The focus/topic of my talk today is…* (Topik/fokus dari pembicaraan saya hari ini adalah…)
    - etc

- ***Purpose*** **(Tujuan Presentasi)**
    - *We are here today to learn about…* (Hari ini kita akan mempelajari tentang…)
    - *The aim today is to…* (Tujuan hari ini adalah untuk…)
    - *Hopefully, this talk will act as a springboard for discussion* (Semoga pembicaraan hari ini dapat berperan sebagai batu loncatan untuk berdiskusi)
    - etc

- ***Length*** **(Durasi Penyampaian)**
    - *I plan to speak for about ... minutes* (Saya akan berbicara selama …menit)
    - *I shall only take ... minutes of your time* (Saya hanya membutuhkan waktu anda selama …)
    - etc

*Catatan: lamanya durasi hanya disebutkan jika ada lebih dari satu pembicara

- ***Outlining*** **(Skema Materi)**
    - *I've divided my talk into a few sections: ...* (Saya membagi penyampaian saya ke dalam beberapa bab yaitu…)
    - *This subject can be looked at under the following headings: ...* (Topik ini dapat kita lihat dalam bab-bab berikut…)
    - etc

- ***Questions*** **(Sesi Pertanyaan)**
    - *I'd be glad to answer any questions at the end of my talk* (Saya akan dengan senang hati menjawab pertanyaan Anda di akhir penyampaian saya)
    - *Please hold your questions until the end of my presentation* (Mohon simpan pertanyaan Anda sampai presentasi saya selesai)
    - *If you have any questions, please feel free to interrupt* (Bila ada pertanyaan, silahkan menginterupsi)
    - etc

Apabila dirangkaikan, maka bentuk pembukaan presentasi ini dapat diwujudkan sebagai berikut.

"Good morning, everyone. My name is _____ and I'm a _____ at _____ company. Today, I'd like to talk to you about _____ and hopefully, this will act as a springboard for discussion. I plan to speak for about ____ minutes, and my talk will be divided into 3 sections; the first is _____. And second, we'll learn about _____. Finally, I will explain _____. I'd sure be glad to answer any questions at the end of my presentation, so please hold your questions if you have any."

(Selamat pagi, semuanya. Nama saya _____ dan saya adalah seorang _____ dari perusahaan _____. Hari ini, saya akan menyampaikan tentang _____ dan saya harap, ini akan menjadi batu loncatan untuk berdiskusi. Saya akan berbicara selama _____ menit, dan penyampaian saya terbagi ke dalam tiga bab; yang pertama yaitu _____. Dan kedua, kita akan membahas tentang _____. Dan terakhir, saya akan menjelaskan tentang _____. Saya akan dengan senang hati menjawab pertanyaan di akhir presentasi, jadi mohon simpan dulu jika Anda ada pertanyaan)

Cara Memulai Presentasi dalam Bahasa Inggris 2

Yang kedua, kita akan membahas tentang cara unik untuk memulai sebuah presentasi. Cara ini menargetkan audience untuk mengarahkan perhatian sepenuhnya kepada kita lewat umpan yang kita berikan.

Dibandingkan membuka presentasi dengan cara yang membosankan dengan salam dan perkenalan, kita bisa mencoba beberapa tips berikut:

- ***Give a question that matters to the audience*** **(Memberikan pertanyaan yang berkenaan dengan kehidupan para pendengar)**

Yang membuat audience seringkali bosan adalah sebab penyampai presentasi tidak komunikatif dan hanya sekedar bermonolog. Untuk itu, kita dapat memancing simpati mereka dengan melemparkan pertanyaan yang berhubungan dengan kehidupan mereka untuk membentuk sebuah ikatan. Akan lebih baik jika pertanyaan ini nantinya berkaitan dengan materi yang akan dibahas.

Contoh:

"Do you ever wonder why kids nowadays seem to rebel a lot?" (Pernahkah Anda bertanya-tanya mengapa anak-anak sekarang jadi seperti suka menentang?)

- ***Tell a shocking factoid*** **(Sampaikan informasi yang mengejutkan)**

Alternatif lain untuk membuka presentasi dan memancing perhatian pendengar adalah dengan menyebutkan sebuah informasi yang dipercaya sebagai sebuah fakta yang cukup mencengangkan.

Contoh:

"Facebook, the social media you've been using for years, is actually 'stealing' your data." (Facebook, media sosial yang telah Anda gunakan bertahun-tahun, sebenarnya sedang 'mencuri' data Anda)

- ***Start with a story-telling*** **(Bacakan cerita)**

Yang terakhir, kita bisa membuka suatu presentasi dengan membacakan cerita apa saja atau mungkin pengalaman yang kita miliki. Entah itu sebuah kisah penuh pesan bijak atau anekdot, pastikan kita dapat menyampaikannya dengan baik dan menarik.

Thanks to the moderators for your time. The honorable ladies and gentlemen of the AESAP seminar participants. Previously, I introduced the names of I Ketut Budaraga, lecturer of the Agricultural Product Technology Study Program, Faculty of Agriculture, Ekasakti University and Rera Aga Salihat as members of the same institution. Today I will present a paper entitled Heavy metals analysis (Cd, Pb, Zn, Cu, Cr) and calcium in Padang and Padang Panjang fresh cow's milk.

Cd. Non Detection (ND) for LM and PP

zero point zero zero five ppm by WHO

Pb. Thirteen point fifty eight plus minus one point zero one ppm for LM padang

Twenty point five eight plus minus two point zero

Two ppm for Padang Panjang

Zero point zero two ppm by WHO

Zn. Twenty eight point eighty three plus minus one

point eight one ppm for LM Padang

Fifty three point blank eight plus minus two point

Forty ppm for Padang Panjang

five ppm by WHO

Cu. One point seventeen plus minus zero point thirty

Eight ppm for LM Padang

Two point seventeen plus minus zero point three

Eight ppm for Padang Panjang

one point three ppm by WHO

Cr. Non Detection (ND) for LM and PP

zero point one ppm by WHO

Ca. Six hundred and seventy four plus minus two point four six ppm LM Padang

Five hundred four point twenty five plus minus two point sixty three ppm for PP

Attendance Confirmation 4th AESAP | International Conference on Agricultural Engineering for Sustainable Agriculture Production 2021 - Day 2 (12 October 2021)

Thank you for your registration in The 4th International Conference on Agricultural Engineering for Sustainable Agriculture Production (AESAP) 2021. Herewith attached the Zoom link for the conference; Join Zoom Meeting: | https://ipb-university.zoom.us/j/94788349857?pwd=RE8rQ1doT1VlSTNjak9HRnl6alpNdz09 | Meeting ID: 947 8834 9857 Passcode: 853902

Edit jawaban Anda

Heavy metals analysis (Cd, Pb, Zn, Cu, Cr) and calcium in Padang and Padang Panjang fresh cow's milk

I Ketut Budaraga, Rera Aga Salihat
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Introduction

- Citizen population growth and improvement in income that is followed by public awareness on the importance of a healthy lifestyle cause an increase in demand for fresh and processed cow's milk.
- Milk is considered a complete food because it contains essential nutrients including protein, essential fatty acids, lactose, vitamins, and minerals in balanced proportions.
- However, milk can also contain chemical hazards and contaminants, which are technological risk factors for dairy products, for the associated commercial image, and most importantly, for consumer health. One group of hazardous chemicals that can contaminate fresh milk are heavy metals.
- Heavy metals also cause food contamination which is one of the main reasons for maintaining food safety concerns.

Introduction

- Because of the rapid developments in industry and agriculture, the assessment of heavy metal contamination in fresh milk and its derivatives has become very important.
- This also applies in the city of Padang and Padang Panjang.
- The purpose of this study was to determine the metal content of Lead (Pb), Zinc (Zn), Copper (Cu), Cadmium (Cd), Chrom (Cr), and Calcium (Ca) in pure cow's milk from two different locations.

Methodology

1. Sample Collection

Samples of fresh cow's milk were obtained from dairy farms located in two different locations, which are: Lubuk Minturun in Padang City and Padang Panjang City to determine the levels of Lead (Pb), Zinc (Zn), Copper (Cu), Cadmium (Cd), Chrom (Cr) and Calcium (Ca) using the Atomic Absorption Spectrophotometry (SSA) method.

2. Sample Preparation

Fresh milk samples (5 mL or g) were destructed with a mixture of nitric acid and perchloric acid (HNO_3: $HClO_3$ = 4:1 v/v) until a transparent solution was obtained.

After digestion, the sample is filtered and diluted to a predetermined concentration.

Methodology

3. Sample Analysis

Standard solutions with concentrations of 10 ppm, 20 ppm, 30 ppm, 40 ppm, and 50 ppm were measured using an AAS at a wavelength and a cathode lamp according to the metal to be analyzed. The standard curve is made by plotting the absorbance value against the concentration of the solution (ppm).

The same treatment was also used in the solution of fresh cow's milk samples.

4. Statistic analysis

Concentrations of all metals are reported as mean±SD. Each metal was analyzed at least three times for each sample.

Result and Discussion

- The concentrations of heavy metals (Cd, Pb, Zn, Cu, Cr) and calcium contained in fresh milk samples from two different farm locations, namely: Lubuk Minturun Padang (LM) and Padang Panjang (PP) are shown in table on the right.
- Maximum metal limits The weight reference in this article is the Maximum Contaminant Level (MCL) set by the World Health Organization (WHO) in Geneva, Switzerland.
- The unit used is ppm which is equivalent to mg/Kg.

Metal	LM (ppm)	PP (ppm)	MCL by WHO (ppm)
CD	ND	ND	0.005
Pb	13.58±1.01	20.58±2.02	0.02
Zn	28.83±1.81	53.08±2.40	5
Cu	1.17±0.38	2.17±0.38	1.3
Cr	ND	ND	0.1
Ca	674.00±2.46	504.25±2.63	-

*Mean±SD; *ND:Not Determined, ND means <LOD
*LM: Lubuk Minturun Area
*PP: Padang Panjang Area
*MCL:Maximum Contaminant Level

Result and Discussion

- Cadmium (Cd)

Cadmium contamination (ppm) of fresh milk samples from two different farm locations was not detected as can be observed in Table. This proves that the soil and water that are the source of dairy cattle feed are not contaminated by cadmium. In addition, the livestock equipment used also does not contain cadmium which can contaminate the fresh milk produced. The maximum limit for cadmium contamination in milk set by WHO is 0.005 ppm.

Metal	LM (ppm)	PP (ppm)	MCL by WHO (ppm)
CD	ND	ND	0.005
Pb	13.58±1.01	20.58±2.02	0.02
Zn	28.83±1.81	53.08±2.40	5
Cu	1.17±0.38	2.17±0.38	1.3
Cr	ND	ND	0.1
Ca	674.00±2.46	504.25±2.63	-

*Mean±SD; *ND:Not Determined, ND means <LOD
*LM: Lubuk Minturun Area
*PP: Padang Panjang Area
*MCL:Maximum Contaminant Level

Result and Discussion

- Lead (Pb)

The lead content in fresh milk samples from Lubuk Minturun (LM) detected was 13.58 ±1.01 ppm, while the lead contained in the sample from Padang Panjang was 20.58±2.02 ppm as can be seen in the Table. The maximum limit for lead contamination in fresh milk set by WHO is 0.02 ppm.

From this data, it can be said that the fresh milk samples from the two places contain lead with concentrations far exceeding the maximum limit allowed by WHO, in other words, it is harmful to health if consumed both in the short and long term. The high lead content in fresh milk may be due to soil and water being exposed to high lead sources near polluted locations, such as landfills.

Metal	LM (ppm)	PP (ppm)	MCL by WHO (ppm)
CD	ND	ND	0.005
Pb	13.58±1.01	20.58±2.02	0.02
Zn	28.83±1.81	53.08±2.40	5
Cu	1.17±0.38	2.17±0.38	1.3
Cr	ND	ND	0.1
Ca	674.00±2.46	504.25±2.63	-

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Result and Discussion

- Zinc (Zn)

The table displays data on zinc content in fresh milk samples from two different locations, namely Lubuk Minturun (28.83 ±1.81 ppm) and Padang Panjang (53.08±2.40 ppm).

The zinc content in samples from Padang Panjang was greater than those from Lubuk Minturun. Even so, both values far exceed the maximum zinc content in fresh milk that has been set by WHO, which is 5 ppm. The presence of zinc in high concentrations is thought to come from the use of livestock equipment used and feed contaminated with heavy metals.

Metal	LM (ppm)	PP (ppm)	MCL by WHO (ppm)
CD	ND	ND	0.005
Pb	13.58±1.01	20.58±2.02	0.02
Zn	28.83±1.81	53.08±2.40	5
Cu	1.17±0.38	2.17±0.38	1.3
Cr	ND	ND	0.1
Ca	674.00±2.46	504.25±2.63	-

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Result and Discussion

- Copper (Cu)

Copper detected in fresh milk samples from the Lubuk Minturun location was 1.17±0.38 ppm. This value is lower than the maximum limit for copper content in fresh milk allowed by WHO, which is 1.3 ppm. Meanwhile, the copper content in the samples from Padang Panjang was 2.17±0.38 ppm exceeds the maximum allowable limit.

This higher copper content could be due to contamination from the livestock equipment used. In addition, the feed and water used for dairy cows can also be contaminated with heavy metals from the surrounding environment.

Metal	LM (ppm)	PP (ppm)	MCL by WHO (ppm)
CD	ND	ND	0.005
Pb	13.58±1.01	20.58±2.02	0.02
Zn	28.83±1.81	53.08±2.40	5
Cu	1.17±0.38	2.17±0.38	1.3
Cr	ND	ND	0.1
Ca	674.00±2.46	504.25±2.63	-

*Mean±SD; *ND:Not Determined, ND means <LOD
*LM: Lubuk Minturun Area
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Result and Discussion

- Chromium (Cr)

Chromium levels (ppm) in fresh milk samples from two different farm locations were not detected as shown in the Table. Chromium contamination usually comes from the use of metal-based livestock equipment. In addition, chromium can also contaminate animal feed from soil and water near factory sites and landfills.

It can be concluded that fresh milk from Lubuk Minturun and Padang Panjang farms does not contain chromium with concentrations that can be harmful to health if consumed. WHO sets the maximum limit for chromium contamination in milk is 0.1 ppm.

Metal	LM (ppm)	PP (ppm)	MCL by WHO (ppm)
CD	ND	ND	0.005
Pb	13.58±1.01	20.58±2.02	0.02
Zn	28.83±1.81	53.08±2.40	5
Cu	1.17±0.38	2.17±0.38	1.3
Cr	ND	ND	0.1
Ca	674.00±2.46	504.25±2.63	-

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*LM: Lubuk Minturun Area
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Result and Discussion

- Calcium (Ca)

Milk and its dairy products are foods rich in calcium, which is one of the most important minerals in fresh milk, and the amount varies according to the region and the breed of the dairy cow. In this study, the average calcium content in the fresh milk from Lubuk Minturun was 674.00±2.46 ppm. This value is higher when compared to the calcium content of the samples from Padang Panjang (504.25±2.63 ppm).

The amount of calcium in the samples from these two different locations was higher than the average calcium content in fresh milk, which was 280 ppm.

Metal	LM (ppm)	PP (ppm)	MCL by WHO (ppm)
CD	ND	ND	0.005
Pb	13.58±1.01	20.58±2.02	0.02
Zn	28.83±1.81	53.08±2.40	5
Cu	1.17±0.38	2.17±0.38	1.3
Cr	ND	ND	0.1
Ca	674.00±2.46	504.25±2.63	-

*Mean±SD; *ND:Not Determined, ND means <LOD
*LM: Lubuk Minturun Area
*PP: Padang Panjang Area
*MCL:Maximum Contaminant Level

Conclusion

Among all the heavy metals analyzed, cadmium, copper, and chromium contained in fresh milk samples from these two locations were below the maximum limit set by WHO.

Meanwhile, the calcium content contained in the fresh milk samples from the two locations was quite high when compared to the average calcium content in fresh milk in general.

However, for lead and zinc, the contamination is above the maximum allowable limit.

Therefore, fresh milk from these two locations is dangerous for human consumption.

Further studies are needed to determine the exact cause of heavy metal contamination in fresh milk originating from the Lubuk Minturun and Padang Panjang locations so that a good solution can be found so that the fresh milk produced from these two locations is safe for consumption in the future.

THANK YOU
FOR YOUR ATTENTION

Heavy metals analysis (Cd, Pb, Zn, Cu, Cr) and calcium in Padang and Padang Panjang fresh cow's milk

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Heavy metals analysis (Cd, Pb, Zn, Cu, Cr) and calcium in Padang and Padang Panjang fresh cow's milk

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Abstract. Cow's milk is important in a healthy food intake because of its high calcium content. However, the contamination in milk can be harmful to health. The acidity of cow's milk decreases with the increase of heavy metals concentration that is poisonous to the body. This research aims to investigate the content of heavy metals (Cd, Pb, Zn, Cu, Cr) and minerals Ca contained in fresh cow's milk samples from two different locations, which are Padang city and Padang Panjang city. The heavy metal content in fresh milk from these two places has never been tested. The quantitative method used in this research is Atomic Absorption Spectroscopy (SSA). The average heavy metal and Ca minerals contained in samples of fresh milk from the Lubuk Minturun area are: cadmium (Cd) not detected, lead (Pb) 13.58±1.01 ppm, zinc (Zn) 28.83±1.81 ppm, copper (Cu) 1.17±0.38 ppm, chromium (Cr) not detected, and calcium (Ca) 674.00±2.46 ppm. Meanwhile, fresh milk samples from Padang Panjang area: cadmium (Cd) not detected, Pb 20.58±2.02 ppm, Zn 53.08±2.40 ppm, Cu 2.17±0.38 ppm, chromium (Cr) not detected, and Ca 504.25±2.63 ppm. All samples from both regions showed heavy metal content of Pb, Zn, and Cu which exceeded the maximum limit set by the Environmental Protection Agency (EPA), consequently it could cause negative impacts on health when consumed. This is assumed to be caused by cattle food contamination by garbage and pesticides which requires further research.

1. Introduction

Citizen population growth and improvement in income that is followed by public awareness on the importance of a healthy lifestyle cause an increase in demand for fresh and processed cow's milk. Demand for milk is growing rapidly, this can be seen from Based on data from BPS (Statistics Central Bureau) data in the year 2021, the level of milk consumption per capita of the Indonesian people in 2020 is 16.27 kg/capita/year, it has increased by 0.25 percent from 2019. This makes milk to become an economic commodity that has strategic value.

Milk is considered a complete food because it contains essential nutrients including protein, essential fatty acids, lactose, vitamins, and minerals in balanced proportions [1]. However, milk can also contain chemical hazards and contaminants, which are technological risk factors for dairy products, for the associated commercial image, and most importantly, for consumer health [2]. One group of hazardous chemicals that can contaminate fresh milk are heavy metals.

In the periodic table, elements with a high atomic number and are metallic at room temperature are referred to as heavy metals. These metals have a gravitational force exceeding 5 g/cm3 [3]. Most of the heavy metals are toxic to living things if they accumulate in the body even at low concentrations [4] [5].

Generally, heavy metal contamination is infected from environmental sources such as soil and water or feed consumed by animals. In addition, metals in the composition of machinery and equipment used during milk storage and processing may leach into the product during milking [6].

When heavy metals enter the human body through different sources, it affects the cellular functions leading to metal poisoning. Some are excreted through the liver or kidneys or spleen, but some metals accumulate in some excretory organs and cause organ damage.

Heavy metals also cause food contamination which is one of the main reasons for maintaining food safety concerns. Major food contaminants include pesticides, toxins along heavy metal contamination [7]. Heavy metals can accumulate in appreciable amounts in crops such as rice, grasses, and some types of legumes for animal feed, including dairy cattle [8].

Lead and cadmium residues in milk are of particular concern because they are mostly consumed by infants and children. Food is the main route of lead and cadmium exposure in the general population (representing >90% of total Cd intake in non-smokers), although inhalation can be a major cause in highly contaminated areas [9]. Lead and cadmium are considered potential carcinogens and are etiologically associated with several diseases of the cardiovascular system, kidneys, nervous system, blood, and skeletal system. Heavy metals that enter the body through food, in addition to disrupting the nervous system, paralysis, and premature death, can also reduce children's intelligence levels [10].

Contamination of .copper metal in foods initially occurred due to excessive use of fertilizers and pesticides[8]. The maximum limit for the copper metal in drinking water set by the EPA is 1.3 ppm. However, copper is a constituent that must be present in the human diet and is needed by the body (Acceptance Daily Intake/ADI = 0.05 mg/kg body weight). At this level, there is no accumulation in the normal human body. However, the intake of large amounts in the human body can cause acute symptoms.

Sensitive organs that are the main targets of heavy metals are soft tissues, such as the kidneys, liver, and central nervous system. Accumulation of heavy metals in dairy animals harms health and processed production. Heavy metal contaminants enter animal systems due to pollution of air, water, soil, and consumption of contaminated feed; Improper manufacturing practices and use of contaminated equipment also contribute to milk contamination with heavy metals [4], [11], [12]. Heavy metals that can be transferred from livestock machinery and equipment are Cu, Zn, Cd, and Pb [13].

Because of the rapid developments in industry and agriculture, the assessment of heavy metal contamination in fresh milk and its derivatives has become very important [14]. This also applies in the city of Padang and Padang Panjang. The purpose of this study was to determine the metal content of Lead (Pb), Zinc (Zn), Copper (Cu), Cadmium (Cd), Chrom (Cr), and Calcium (Ca) in pure cow's milk from two different locations.

2. Methodology

2.1. Sample Collection

Samples of fresh cow's milk were obtained from dairy farms located in two different locations, which are: Lubuk Minturun in Padang City and Padang Panjang City to determine the levels of Lead (Pb), Zinc (Zn), Copper (Cu), Cadmium (Cd), Chrom (Cr) and Calcium (Ca) using the Atomic Absorption Spectrophotometry (SSA) method in the Chemistry laboratory of LL Dikti Region X, Padang, West Sumatra.

2.2. Sample Preparation

Fresh milk samples (5 mL or g) were destructed with a mixture of nitric acid and perchloric acid (HNO_3: $HClO_3$ = 4:1 v/v) until a transparent solution was obtained [15]. After digestion, the sample is filtered and diluted to a predetermined concentration. Standard solutions of Pb, Zn, Cu, Cd, Cr, and Ca were prepared by diluting certified standard solutions to the desired concentration. All reagents used are analytical reagent grade. Very high purity water is used for all dilutions. All glass and plastic items were washed and stored overnight in a 10% (v/v) nitric acid solution. After that, it is rinsed thoroughly with ultrapure water and then is dried.

2.3. Sample Analysis

Standard solutions with concentrations of 10 ppm, 20 ppm, 30 ppm, 40 ppm, and 50 ppm were measured using an Atomic Absorption Spectrophotometer at a wavelength and a cathode lamp according to the metal to be analyzed. The standard curve is made by plotting the absorbance value against the concentration of the solution (ppm). The same treatment was also used in the solution of fresh cow's milk samples.

2.4. Statistic analysis

Concentrations of all metals are reported as mean±SD. Each metal was analyzed at least three times for each sample.

3. Results and Discussion

The concentrations of heavy metals (Cd, Pb, Zn, Cu, Cr) and calcium contained in fresh milk samples from two different farm locations, namely: Lubuk Minturun Padang (LM) and Padang Panjang (PP) are shown in Table 1. Maximum metal limits The weight reference in this article is the Maximum Contaminant Level (MCL) set by the World Health Organization (WHO) in Geneva, Switzerland. The unit used is ppm which is equivalent to mg/Kg.

Table 1. Heavy metal and calcium concentrations of fresh milk samples from two different locations

Metal	LM (ppm)	PP (ppm)	MCL by WHO (ppm)
CD	ND	ND	0.005
Pb	13.58±1.01	20.58±2.02	0.02
Zn	28.83±1.81	53.08±2.40	5
Cu	1.17±0.38	2.17±0.38	1.3
Cr	ND	ND	0.1
Ca	674.00±2.46	504.25±2.63	-

*Mean±SD; *ND:Not Determined, ND means <LOD
*LM: Lubuk Minturun Area *PP: Padang Panjang Area
*MCL:Maximum Contaminant Level

Cadmium (Cd)

Cadmium contamination (ppm) of fresh milk samples from two different farm locations was not detected as can be observed in Table 1. This proves that the soil and water that are the source of dairy cattle feed are not contaminated by cadmium. In addition, the livestock equipment used also does not contain cadmium which can contaminate the fresh milk produced. The maximum limit for cadmium contamination in milk set by WHO is 0.005 ppm. From Figure 1, it can be concluded that fresh milk from Lubuk Minturun and Padang Panjang farms is free from cadmium contamination which can cause poisoning if consumed. Acute symptoms of cadmium poisoning are chest tightness, dry throat and chest tightness, shortness of breath, gasping for breath, distress, and can progress to pneumonia,[8]. Prolonged accumulation of cadmium in excretory organs can cause organ damage and also cause changes in cellular function. Continuous long-term exposure can even cause cancer [16].

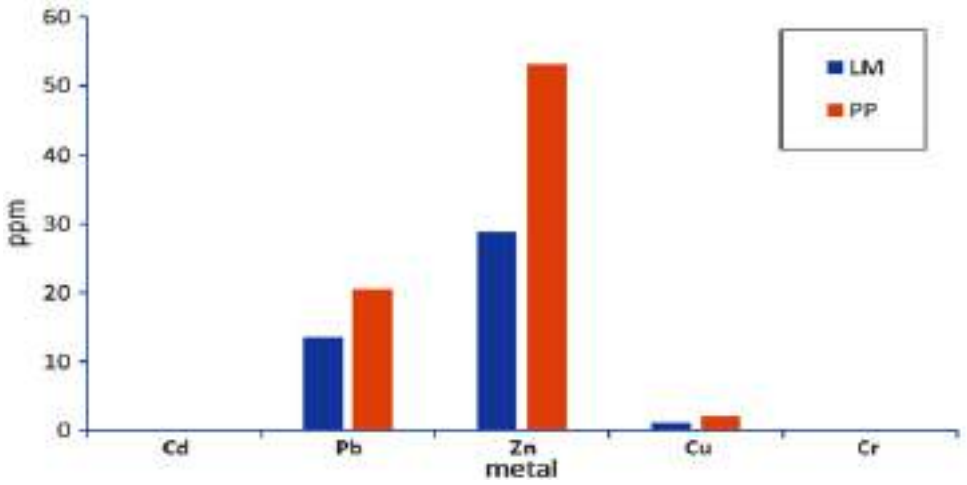

Figure 1. Heavy metal concentrations of fresh milk samples from two different locations (LM and PP).

Lead (Pb)

The lead content in fresh milk samples from Lubuk Minturun (LM) detected was 13.58±1.01 ppm, while the lead contained in the sample from Padang Panjang was 20.58±2.02 ppm as can be seen in Table 1. The maximum limit for lead contamination in fresh milk set by WHO is 0.02 ppm. From this data, it can be said that the fresh milk samples from the two places contain lead with concentrations far exceeding the maximum limit allowed by WHO, in other words, it is harmful to health if consumed both in the short and long term. The high lead content in fresh milk may be due to soil and water being exposed to high lead sources near polluted locations, such as landfills [17], [18].

The presence of high concentrations of lead in milk may also be due to the consumption of feed ingredients and water contaminated by industrial emissions and fertilizers (phosphate rock, which is the basis of commercial fertilizers and sludge), which can contaminate soil and crops that feed cattle. In addition, cows can inhale smoke and dust from industrial activities, and cadmium-coated metal utensils used in commercial food processing, kitchen utensils enamel, and incineration of cadmium-containing plastics [19]. The lead content in the samples from the Lubuk Minturun location is lower than the samples from the Padang Panjang location as shown in Figure 1. This indicates that lead contamination in the dairy farming environment at the Padang Panjang location is higher than in the Lubuk Minturun location.

Zinc (Zn)

Table 1 displays data on zinc content in fresh milk samples from two different locations, namely Lubuk Minturun (28.83±1.81 ppm) and Padang Panjang (53.08±2.40 ppm). The zinc content in samples from Padang Panjang was greater than those from Lubuk Minturun. Even so, both values far exceed the maximum zinc content in fresh milk that has been set by WHO, which is 5 ppm. The presence of zinc in high concentrations is thought to come from the use of livestock equipment used and feed contaminated with heavy metals. Within certain limits, zinc is needed by the body. Zinc is indispensable for the structure and activity of more than 300 enzymes responsible for nucleic acid and protein synthesis, cellular differentiation and replication, insulin secretion, sexual maturation and may also be involved in the functional performance of the immune system and other physiological processes [20]. However, zinc contamination in high concentrations can cause nausea and vomiting in children, anemia, and cholesterol problems in adults [21].

Copper (Cu)

Copper detected in fresh milk samples from the Lubuk Minturun location was 1.17±0.38 ppm. This value is lower than the maximum limit for copper content in fresh milk allowed by WHO, which is 1.3

ppm. Meanwhile, the copper content in the samples from Padang Panjang was 2.17±0.38 ppm exceeds the maximum allowable limit. This higher copper content could be due to contamination from the livestock equipment used. In addition, the feed and water used for dairy cows can also be contaminated with heavy metals from the surrounding environment.

Copper, as an essential trace element, is required for adequate growth, cardiovascular system integrity, lung elasticity, neuron-endocrine function, and iron metabolism [22]. Copper is also recognized as an important redox-active transition metal and an important micronutrient due to its multiple oxidation stages in vivo is involved in many structural and enzymatic activities as it is part of the structure in regulatory proteins and is involved in photosynthetic electron transport, mitochondrial respiration, oxidative stress response, metabolism. cell wall and hormone signaling for plant growth and development when present in optimal concentrations and environmental conditions [23]. The daily intake (mg/day) for copper in milk and dairy products ranged from 0.002 to 0.0191 mg/day. Nevertheless, copper harms the human body in high concentrations. Due to contamination, copper can reach high levels in milk and dairy products [21].

Chromium (Cr)

Chromium levels (ppm) in fresh milk samples from two different farm locations were not detected as shown in Table 1. Chromium contamination usually comes from the use of metal-based livestock equipment. In addition, chromium can also contaminate animal feed from soil and water near factory sites and landfills. From Figure 1, it can be concluded that fresh milk from Lubuk Minturun and Padang Panjang farms does not contain chromium with concentrations that can be harmful to health if consumed. WHO sets the maximum limit for chromium contamination in milk is 0.1 ppm. Chromium is known as an essential element for normal carbohydrate metabolism in animal and human nutrition [24]. However, in excess levels, chromium poisoning can cause skin irritation, accumulate in the liver, and systemic poisoning [25].

Calcium (Ca)

Calcium is responsible for many functions in the body such as heart rhythm, blood clotting, hormone secretion, muscle contraction, activation of enzymes in the body, and is also needed in bone structure. Calcium makes up 1.5-2% of the mass of an adult. Milk and its dairy products are foods rich in calcium, which is one of the most important minerals in fresh milk, and the amount varies according to the region and the breed of the dairy cow [26]. In this study, the average calcium content in the fresh milk from Lubuk Minturun was674.00±2.46 ppm. This value is higher when compared to the calcium content of the samples from Padang Panjang (504.25±2.63 ppm). These two data can be seen in Figure 2. The amount of calcium in the samples from these two different locations was higher than the average calcium content in fresh milk, which was 280 ppm [27]–[29]. Based on the results of this study, it appears that the calcium content in fresh milk samples from two locations (LM and PP) can be a good source of nutrition for humans regardless of heavy metal contamination due to contaminated equipment, feed, and water.

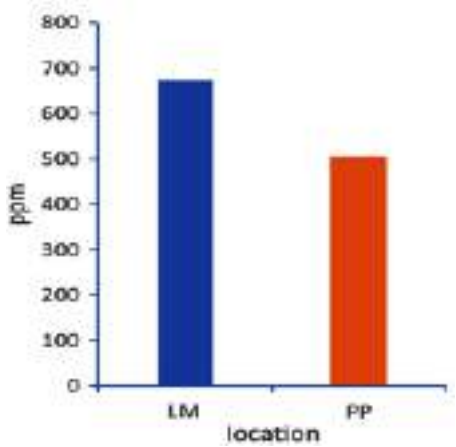

Figure 2. Calcium concentration of fresh milk samples from two different locations (LM and PP).

4. Conclusion

Information on the presence of heavy metals in dairy products from local farms is not available, which is necessary for policymaking, standard formation, and for taking corrective action, if available. This study is needed to evaluate the content of heavy metals and calcium in fresh milk samples from Lubuk Minturun Padang and Padang Panjang locations to confirm the health risks if the milk is consumed. Among all the heavy metals analyzed, cadmium, copper, and chromium contained in fresh milk samples from these two locations were below the maximum limit set by WHO. Meanwhile, the calcium content contained in the fresh milk samples from the two locations was quite high when compared to the average calcium content in fresh milk in general. However, for lead and zinc, the contamination is above the maximum contaminant level (MCL). The lead content in fresh milk samples were 13.58±1.01 ppm (Lubuk Minturun) and 20.58±2.02 ppm (Padang Panjang). And zinc content in fresh milk samples were 28.83±1.81 ppm (Lubuk Minturun) and 53.08±2.40 ppm (Padang Panjang). Therefore, fresh milk from these two locations is dangerous for human consumption. Further studies are needed to determine the exact cause of heavy metal contamination in fresh milk originating from the Lubuk Minturun and Padang Panjang locations so that a good solution can be found so that the fresh milk produced from these two locations is safe for consumption in the future.

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