Media Ilmiah Teknologi Pangan
Vol. 2, No.2, 141–147, 2015
ISSN : 2407-3814 (*print*)

ISSN : 2477-2739 (*e-journal*)

Coffee Area (Subak Abian Tri Guna Karya Kintamani Bangli) Based Waste Management Potential to Generate Renewable Energy Sources and Nutrition

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Diterima 16 Juni 2015 / Disetujui 30 Juni 2015

ABSTRACT

Bali island has 5.632.86 km2 area with a total area of 36.298 hectares of coffee farm in 2004 with production 3.696.206 15386.405 tons of Arabica coffee and Robusta coffee produces tons of waste is high enough. The results of the proximate analysis of robusta coffee waste containing protein, crude fiber and fat is high at 6.67 to 12.43% crude protein, fiber kasar11,05-21,40%, fat 1.04 to 1.07%, while the calcium 0 , 21 to 0.34% and 0.02-0.07% phosfor.

Materials (coffee waste) inserted through the container revenue in accordance with the treatment, then allowed to ferment anaerobically for 35 days, if the bio-gas already formed in large volume, then the bio-gas flow from the inner tube to cleaners tube which then exits through a gas hose. Bio-gas has started to form when the water in the U manometer and hose materials pointer moves upward.

Parameters measured were the temperature of the fermentation medium was measured with a thermometer scale 0-100^{o}C. Volume of bio-gas can be shown on the hose raw material pointer was the changes of the surface of raw material height multiplied by its width. Gasbio pressure inside the bioreactor was measured using a manometer U scaleD 3-3 cm. gasbio production was measured by thermik properties of the gas or through the ideal gas equation (Sutanto, 1982).

Technical analysis measured through the strength of materials, dimensions and weight. The content of gasbio is observed from methanogenic process is methane gas, and of the hydrolysis and acidification processes was carbon dioxide gas using a Shimadzu GC-7A kromatograf model

Chemical analysis of coffee waste and bio-gas as byproduct was crude fiber, nitrogen, fatty acids, calcium, phosphorus, iron, magnesium, manganese, potassium, sodium and zinc as well as caffeine using atomic spetrophotometes.

Handling of coffee waste using region-based bioreactors (Subak Abian Tri to work Kintamani Bangli) generate renewable energy, a source of nutrients and bioactive and spawned a culture of energy saving, clean and healthy

Keywords: *Waste management, energy sources, nutrition*

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INTRODUCTION

Today renewable energy issue is endlessly discussed on various occasions. It is driven by the fact that the need of fuel is increasing due to economical and population growth. Fuel sources such as petroleum, natural gas, non-renewable firewood are non renewable and tend to decrease. Renewable energy is energy which comes from the nature which after initial use will be used again. One of them is bio-gas.

On the other side, the food security and health-related food which being discuss is not less interesting, in which people tends to choose foods that are beneficial in terms of health, not just only fulfill the desire for good quality of food products alone, but also food products to support their health, such as food with sufficient nutrients, low in calories, contains anti-oxidants that increasing immune system, even products that support the healing process of a disease.

Efforts for balancing the need and the supplies can be done by finding and utilizing other sources of material. One source of these materials is utilization of agricultural waste as a renewable energy source, a source of nutrients and bioactive source.

Threare many type of utilization agricultural waste. One of them is as inputs for generating renewable energy such as bio-diesel, bio-gas and crude fiber, nutrients such as protein, fat, minerals and other materials.

Bio-gas is a mixture of several gases that result from the fermentation of organic matter under anaerobic conditions. The dominant gas is methane (CH4) and carbon dioxide (CO). The formation of bio-gas made by microbes in the anaerobic situation that involves three stages, namely hydrolysis, acidification and methanogenic stage. At this stage of hydrolysis occurs dissolving of soluble organic materials and digestion of complex organic materials into simple. At this stage of the acid monomer component (a simple sugar) that was formed in the hydrolysis stage will be food sources for acid-forming bacteria. The final product of this process is acetic acid, propionic acid, formate, lactate, alcohol, butyrate, carbon dioxide, hydrogen and ammonia. While in methanogenic process methane is formed.

Anaerobic bacteria that play a role in the process include: acid-forming bacteria (Acidogenic bacteria) which reorganizes the organic compounds into simpler compounds such as CO2, H2S and H2, and acetic acid-forming bacteria (Acetogenic bacteria) converts organic acids, bigger neutral compounds and methanol into acetate and hydrogen.

Equipment used to produce bio gas called bioreactors. Bioreactor is a unit of equipment, used as a place for a biochemical process from raw materials into a material or substance that is desired, catalyzed by an enzyme of live microbial or isolated enzymes (Judoamidjojo *et al*, 1992).

According to Junus (1995) there are three models of gasbio units introduced to public,: the first model in which most of the digester are below ground level, the second model, the entire digester tanks are below ground level and the third model, the entire digesters tank are on the ground.

The first and second models need high manufacturing costs, requires a broad place and it is difficult to find if leak occurr in the wall of the digestive tank. The advantages of both models are to large amounts of bio-gas produced as large volume of digestive tanks. While the third models, the digestion tank volume is small, so that little gas is produced, but the unit can be moved to desired places.

Many benefits are obtained through bioreactor in the manufacturing of gasbio, i.e energy procurement, applicable technology that responds to the needs of society, especially in the processing of waste to reduce environmental pollution.

The choice of using of bioreactors as gasbio technology, usually include in a package of decentralized sewage treatment system (area-based waste treatment). In contrast to the individual-based waste treatment and central-based with public participation or not even with a participatory approach. A participatory approach is the involvement of physical, mental, emotional, mind and attitude of a person in a situation of group activities and to ensure that everyone contribute equally in determining the outcome of the group and in the responses.

Through optimizing the use of bioreactor in area-based waste handling will produce bioenergy, biodiesel, nutrients and bioactive that have high economic value and also will delivera culture of energy saving, clean and healthy that can encourage community creativity to utilize what is around as an ingredient or a new energy source.

In this paper the materials used are coffee waste, considering until now the coffee waste only used for fertilizer alone, whereas the waste can be processed into products which have a high economic value, namely renewable energy, sources of nutrients and other resources where the possibility of the coffee fruit skin still contains caffeine, as well as other active ingredients.

The use of bioreactors for coffee waste handling to produce renewable energy is still minimal. This paper is expected to be a reference of how to the handle waste that is appropriate with the needs of farmers in a region of coffee farm.

METHODES

Subak Abian Tri Guna Karya, Kintamani, Bali Province profile

Farmers

- Farmers are members of Subak Abian Tri Guna Karya
- Type of coffee is cultivated
- The area is managed by an average of 31.5 acres
- The number of plants ranging from 600 - 1200 trees per ha (mixing it with orange)
- Average production: 1489 kg per ha red glondong

Harvesting

- Harvesting methods: manually
- Color of harvested coffee: red
- Harvesting time: am to pm
- Container: basket
- Harvesting periods: 45 days
- Harvested volume: an average of 150 kg / day at the beginning of harvest, 900 kg / day in midharvest, 449 kg / day at the end of the harvest by picking hose every 10-15 days.

Marketing and transportation

- Harvested coffee: did not sell, but processed at the Subak' processing
- Transportation of harvested coffee: done the farmers them self, in less than 0.5 hour trip.

Processing

- Method of processing performed: the wet method
- Processing of coffee: cultivated coffe were either and processed bythe farmers themselves or by the operator of Subak abian especially in pulpering
- The fermentation, washing and drying processes could be done at home or at the processing plant
- The amount of coffee that is processed: an average of 157 kg per day
- Drying is done by placing the coffee on the floor that is covered by thick plastic or "anyaman bamboo"
- Results: HS dried coffee

Coffee processing equipment

- Thre are 7 types of equipment owned by "Subak abian Tri Guna Karya" i.e. pulper machine fused with huller, washing machines, Fermentation vessels, bamboo mat, drying floor, tarpaulins

Coffee's hull waste

Coffee' hull consists of 3 (three) parts, namely: 1). The thin outer layer called "exocarp"; This layer is red when fully ripe. 2). The pulp layer; The fruit pulp contains fiber which when fully ripe slimy and tastes sweet, it is often preferred by animal, monkey or a ferret. The fruit flesh is called "mesocarp". 3). Horn skin layer or deep skin; This horn skin layer is the boundary layer of the skin and seeds are somewhat harsh layer. This skin called "endocarp".

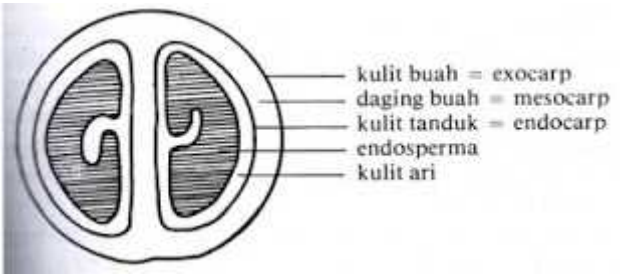

Figure 1. Layers of hull of coffe bean (Wikipedia. 2010)

Waste of coffee'hull obtained from processing of whole bean coffee into coffee powder. Thre are 2 types of coffee processing namely (1) Processing of red coffee /ripe coffe and (2) Processing of green coffee /unripe. Red coffee processing begins by washing, soaking and removing the outer skin, this process resulted in 65% coffee beans and 35% coffee's hull waste.

Indicators studied

Coffee waste mostly used as fertilizer for coffee plants, other plantation surrounding, and a small portion used as medium for cultivation of mushrooms as well as for traditional herbal medicine. Coffee beans obtained were then dried using oven and then milled. These processes yield as much as 31% oven dried beans, 21% of rice coffee (coffee powder) and 10% deep layer skin in the form of waste. Waste generated from this process (in the skin) are generally used as fertilizer, but some of them used by craftsmen as a traditional herbal medicinal ingredients.

Chemical constituents of coffee's hull, affected by the processing method whether it is wet or dry, as shown in Table 1 Chemical ingredients hull according to method of processing coffee. In wet processing method, the

Table 1. Composition of coffee pulp

Component	Percentage
Ether extract	0.48
Crude fibre	21.40
Crude protein	10.10
Ash	1.50
Nitrogen free extract	31.30
Tannis	7.80
Pectic substances	6.50
Non reducing sugars	2.00
Reducing sugars	12.40
Chlorogenic acid	2.60
Caffein2	2.30
Total caffeine acid	1.60

Saurce : Wikipedia,(2010)

coffee fruit peeler is placed in the tank and then doused with water, pulping machine separates the seeds from the hull. While in dry processing methods is simpler, usually coffee fruit was allowed drying on the tree before harvesting. Furthermore, dried harvested coffee were separated using machine.

Processing Of Coffee Waste To Renewable Energi Source And Feed Source

In Indonesia, biogas technology has been known since a long time and the results of bio-gas has been used by the public such as to fuel stoves, refrigeration and lights up the motor generator. Factually this technology is not enough developed, due to various constraints, especially in the use of materials, systems and biorektor design. In terms of general system both individual-based and centrally based system, public participation was minimal. This paper will discuss management of coffee waste, based on area.

Biogas is a mixture of gases produced by the decomposition of organic compounds in the form of gases lain. Bio-gas weigh 20% lighter than air and has heat combustion value between 4800-6700 kcal / m3. This value is slightly lower than the value of pure methane combustion are which reaches 8900 kcal / m3. While external factors that affect the process is temperature, feeding rate, stirring and consistency of inputs, as well as the staying time in the reactor (Tong, & Jaafar, 2005).

Biogas reactor or bioreactor can also be an alternative option for treating liquid waste of coffee through anaerobic processing method (Figure 2).

Bioreaktor's working principles

Materials (coffee waste) inserted through the container revenue in accordance with the treatment, then allowed to ferment anaerobically for 35 days, if the bio-gas already formed in large volume, then the bio-gas flow from the inner tube to cleaners tube which then exits through a gas hose. Bio-gas has started to form when the water in the U manometer and hose materials pointer moves upward.

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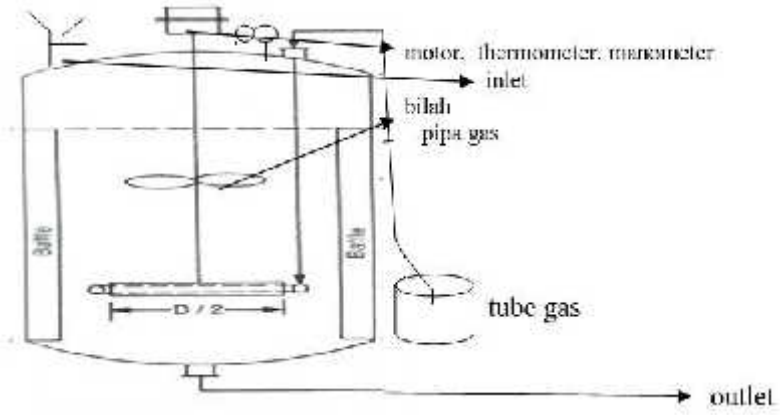

Figure 2 Biogas reactor or bioreactor

content of gasbio is observed from methanogenic process is methane gas, and of the hydrolysis and acidification processes was carbon dioxide gas using a Shimadzu GC-7A kromatograf model.

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RESULTS AND DISCUSSIONS

The energy content

The composition of biogas varies depending on the origin of the anaerobic process occurs. Landfill gas has a methane concentration of about 50%, while the advanced waste treatment biogas can produce 55-75% methane. Caloric value of 1 cubic meter of biogas about 6,000 watt hours which is equivalent to half a liter of diesel oil. Furthermore according to the study half cubic of the processed waste could blamed the tank reactor for almost 2 hours., While generators of electricity generated from biological energy capable of supplying power about 750 watts to 1000 watt. Therefore biogas is very suitable for use as an alternative fuel that is environmentally friendly substitute for kerosene, LPG, butane, coal and other materials derived from fossil because the cost for fuel production machines can be suppressed up to 30%. Application of the result at public community, will reduce energy dependence on fossil fuels which increasingly expensive.

Metanogenik Bacteria

Methanogenic bacteria or methanogen are bacteria found in organic materials that produce methane and other gases in the overall process chain in an anaerobic life, as living organisms, with a tendency to like certain conditions and is sensitive to the micro-climate within the digester. There are various spicies of methanogens and variations of its properties.

Methane-forming bacteria -bakteri have physiological properties such as bacteria in general, but the cell morphology was heterogeneous.

Methanogenic bacteria grow slowly and are sensitive to sudden changes in physical and chemical conditions.

CONCLUSSION

Handling of coffee waste using region-based bioreactors (Subak Abian Tri To Work Kintamani Bangli) generate renewable energy, a source of nutrients and bioactive and spawned a culture of energy saving, clean and healthy.

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