ANALYSIS OF THE ADDITION OF COCA-COLA SLUDGE FOR QUALITY COMPOST PRODUCTION

I Dewa Made Arthagama[1*], I Made Dana[1]
[1]Study Program of Agroecotechnology, Faculty of Agriculture, Udayana University, Denpasar, Bali, Indonesia
**Corresponding author: arthagama@unud.ac.id*

ABSTRACT

Bali as a tourist destination makes a perfect location for the soft drink industry, Coca-Cola, to build their factory which is located in Mengwi District, Badung Regency, Bali, Indonesia. In the production process of the beverage industry, of course, it produces by-products in the form of solid waste sludge that is not utilized. This study aims to determine the compost formula with the addition of Coca-cola sludge to improve the quality of the compost. This research was conducted from June to July 2021, using a completely randomized design (CRD) consisting of 11 formulations of compost material, which was repeated 3 times so that 33 experiments were obtained. The results showed that the treatment G = (2.5 kg goat manure + 1.5 kg rice straw + 0.5 kg Coca-cola sludge) gave the best compost quality as indicated by the highest N, P, and K parameter values, the best C/N ratio, and pH approach to neutral. It should be tried to be applied in the field for plant growth and production using several plants and in several types of soil.

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INTRODUCTION

Various kinds of industries, both on a small scale to a large scale, have recently developed in Bali, Indonesia, one of which is the food processing industry. Nasir et al. (2015) said that industrialization is an alternative choice of development model that is mandatory for various countries, including Indonesia, to support economic growth, however, the impact due to increased industry must still be watched out for. Waste which is a by-product of production in liquid, solid and other forms is still a serious problem for the industry because it has the potential to trigger negative impacts on the environment. According to Correy et al. (1987), food industry waste generally contains a lot of heavy metals such as Cd, Cu, Pb, Zn, Cr, Co, Fe, Mn and others, the impact is not good on the environment

There are two alternatives that can be proposed to solve the problem of industrial waste, namely first destroying or getting rid of the waste or second processing the waste into useful materials to support

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development (Supadma and Arthagama, 2008). According to Law no. 23 of 1997 concerning environmental management states that it is best if the waste produced can be managed and utilized followed by pollution control and degradation of environmental quality and natural resources. For this reason, research is needed to reuse this waste which has been processed so that it is environmentally friendly (Paratenta and Irianty, 2012).

Bali as a developing tourist destination is also a location for the soft drink industry, one of which is Coca-Cola which is located in Mengwi District, Badung Regency. In the production process of the beverage industry, of course, it produces by-products in the form of solid waste sludge that is not utilized. It was further stated that Coca-Cola waste includes solid waste with a water content of 80% which has undergone a bioactive process. In a day the waste generated from the by-product of Coca-Cola beverage production can reach 5-6 tons. Coca-Cola waste contains very high nitrogen (N-total) (1.81%), very high potassium (K_2O) (1583.33 ppm), very high phosphorus (P_2O_5) (522.18 ppm), neutral pH (7.30), C/N (29.95) and moderate salt content (2.95%) (Alexandersson, 2007).

Apart from Coca-Cola industrial waste, agricultural waste such as rice straw, cow manure and goat manure are good for composting. The existence of this waste is quite a lot and easy to obtain considering that most Balinese people still rely on the agricultural sector. According to Dewi et al., (2017) states that cow manure has a chemical content including nitrogen 0.4 - 1%, phosphorus 0.2 - 0.5%, potassium 0.1 - 1.5, water content 85 - 92% , and several other elements (Ca, Mg, Mn, Fe, Cu, Zn). According to Anonymous (2011) goat manure contains 1.26% N, 16.36 Mg.kg-1 P, 2.29 Mg.L-1, Ca, Mg and 4.8% C-organic. Meanwhile, rice straw according to Ansari et al. (2014) contains 40% carbon, 0.6% nitrogen, 0.1% sulfur, 1.5% silicate. Therefore, the livestock and agricultural wastes have the potential to be used as basic ingredients for compost and with the addition of Coca-Cola waste it is hoped that later this can improve the quality of the compost. Senensi (1993) states that good quality compost is obtained from good quality materials as well.

Based on this background, the authors wish to analyse Coca-Cola sludge in the Mengwi Badung District, Bali, Indonesia to be added to compost production, in order to improve the quality of the compost produced, as well as reduce the negative impact of the waste.

MATERIALS AND METHODS

Materials and tools

This research was conducted from June 2022 to July 2022. Coca-Cola sludge collection took place at PT. Coca-Cola Amatil Indonesia, Denpasar-Bedugul Highway, Werdi Bhuana Village, Mengwi District, Badung Regency, Bali, Indonesia. The composting process was carried out at the Experimental Garden of the Faculty of Agriculture, Udayana University and for compost analysis was carried out at the Soil Laboratory of Faculty of Agriculture, Udayana University, Bali, Indonesia. The tools used in making compost are large knives, cutting boards, polybags, buckets, thermometers, scales, shovels, ropes and sprayers. For compost analysis in the laboratory, the tools used include digital scales, erlenmeyer, conductometer, Whatman 42 filter paper, oven, titration tool, shaker machine, spectrophotometer, flamephotometer, test tube, measuring cup, breaker glass, pipette, Kjeldahl flask, distraction tool, pH meters and centrifuges, porcelain cups and funnels.

The materials used in the manufacture of compost include dry rice straw, cow manure, goat manure, Coca-Cola sludge, EM4. For the analysis of compost in the laboratory, the materials used include distilled water, alcohol, diphenylamine indicator, boiling stone, conway indicator, liquid paraffin, boric acid H3BO3, buffer solution, $K_2Cr_2O_7$ 2N, concentrated H_2SO_4, 85% H_3PO_4, 1 N $FeSO_4$, 30% NaOH , indicators N, HCl 25%, NH_4OAc pH 7 1 N, NaOH 50%, H_2SO_4 1 N and NaOH 0.1 N.

Experimental Design

. This study used a completely randomized design (CRD) consisting of 11 formulations which was repeated 3 times to obtain 33 trials of the compost materials, namely:

1. A = 3 kg CM + 1 kg DRS + 0 kg SC
2. B = 2.5 kg CM + 1.5 kg DRS + 0.5 kg SC
3. C = 2 kg CM + 2 kg DRS + 1 kg SC
4. D = 1.5 kg CM + 2.5 kg DRS + 1.5 kg SC
5. E = 1 kg CM + 3 kg DRS + 2 kg SC
6. F = 0.5 kg KS + 3.5 kg DRS + 2.5 kg SC
7. G =2.5 kg GM+ 1.5 kg DRS + 0.5 kg SC
8. H =2 kg GM + 2 kg DRS + 1 kg SC
9. I =1.5 kg GM + 2.5 kg DRS + 1.5 kg SC
10. J =0.5 kg GM + 3.5 kg DRS + 2.5 kg SC
11. K = 3 kg GM + 1 kg DRS + 0 kg SC

Note:

CM: dried cow manure

GM: goat manure

SC: Coca-Cola sludge

DRS: dry rice straw

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RESULTS AND DISCUSSION

The effect of treatment on the observed parameters, from the observed data were analyzed using analysis of variance (ANOVA) according to the design used (CRD). The results of the statistical analysis showed that the experimental treatment had a very significant effect on the composting parameters, namely C-organic, N-total, C/N ratio, available-P, available-K, pH and salt content, but had no significant effect on the moisture content of the compost. The Significance of the Effect of Treatment on Observation Parameters is shown in Table 1.

Table 1. The Significance of the Effect of Treatment on Observation Parameters

No	Parameter	Significance
1	C-organic (%)	**
2	N-total (%)	**
3	C/N rasio	**
4	P-available (%)	**
5	K-available (%)	**
6	pH	**
7	Electrical Conductivity (EC) (mmhos/cm)	**
8	Water content (%)	ns

ns: not significance (P>0,05)

**: significant (P<0,01)

The results of laboratory tests of the compost produced on the parameters observed in each treatment can be presented in Table 2. The treatment of the compost material formulation had a very significant effect on the C-organic content of the compost. The results of the analysis showed that the highest average value of C-organic content was obtained in treatment A (control), namely 33.88%, which was not significantly different from treatments B, C, and D, while the lowest average C-organic content was obtained in treatment G with a percentage of 19.04% which differed significantly from other treatments. The yield of C-organic produced varied, cow manure added with rice straw as a staple ingredient for compost (A= 3kg CM + 1kg DRS + 0 SC) without sludge showed higher C-organic than goat manure mixed with rice straw (K= 3 kg GM + 1 kg DRS + 0 SC), it turns out that the basic ingredients of goat manure compost have better quality than

cow manure so that the weathering process is faster (Anon, 2011).

Likewise, the addition of Coca-Cola sludge helps the composting process. It is proven that the addition of sludge can reduce C-organic compost to an optimal level. The lower the organic C of the compost, the more perfect the weathering process of organic matter during composting is. The process of decomposing organic matter as the basic ingredient of compost is closely related to the number and types of microorganisms it contains. It is suspected that Coca-Cola sludge contains certain microorganisms that help speed up composting.

Table 2. Significant Difference Test Results against Observation Parameters

Treatment	C-organic (%)	N-Total (%)	C/N Ratio	P-Available (ppm)	K-Available (ppm)	pH	EC (mmhos/cm)	Water Content (%)
A	33.88 d	0.98 a	34.93 f	566.55 def	656.68 d	7.42 b	8.08 de	25.81
B	32.62 d	1.20 b	27.53 e	541.85 def	659.01 d	7.44 bc	4.42 ab	29.63
C	31.64 d	1.62 de	19.58 cd	557.87 def	662.39 d	7.47 cd	5.06 abc	23.80
D	32.95 d	1.51 cde	21.77 d	566.15 def	654.43 d	7.50 de	4.26 a	23.89
E	26.24 c	1.57 cde	16.71 abc	506.33 cde	652.22 d	7.57 f	4.50 ab	22.73
F	23.82 bc	1.54 cde	15.44 abc	425.78 bc	652.98 d	7.68 g	4.43 ab	24.02
G	19.04 a	1.67 e	12.45 ab	620.39 f	676.67 d	7.34 a	9.67 ef	26.84
H	22.46 abc	1.66e	13.47 ab	379.64 ab	655.63 d	7.41 b	10.91 f	24.84
I	21.60 ab	1.52 cde	14.30 ab	596.56 ef	601.34 c	7.46 c	10.99 f	22.94
J	24.58 bc	1.55 cde	14.48 a	363.75 ab	514.80 a	7.51 e	7.55 cde	18.25
K	23.75 bc	1.41 c	16.83 bc	485.08 cd	538.15 ab	7.56 f	6.86 bcd	21.68

Based on the statistical analysis, the treatment with the addition of Coca-Cola sludge had a very significant effect on the N-total compost. The highest N-total was obtained in treatment G, the level was 1.67%, which was not significantly different from treatment H, which had a level of 1.66%. The lowest N content was obtained in treatment A which was 0.98%, treatment A was only a mixture of 3 kg of cow dung and rice straw without the addition of Coca-cola sludge. Coca-cola sludge makes a high contribution to compost N because the N-total sludge content is very high (1.27%). In addition to N coming from Coca-Cola sludge, goat manure also makes a good contribution to N-total compost, as evidenced by goat manure with N content of 1.26% (Anon, 2011). Supadma and Arthagama (2008) stated that the higher the N content of the raw material, the higher the N content of the compost. The high N content of compost raw materials causes more active

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decomposing microorganisms such as bacteria, fungi and actinomycetes to weather. Weathering that is actively carried out by microbes will trigger the release of nitrogen and ammonia in the compost so that the N content of the compost is also higher (Cahaya and Nogroho, 2009).

The C/N ratio of compost also differed significantly from one treatment to another. The mixture of compost raw materials and the addition of Coca-cola sludge produced C/N ratios that varied from the highest in treatment A, which was 33.8, to the lowest in treatment G, which was 12.45 (Table 2). The raw material for goat manure mixed with rice straw added to Coca-Cola sludge has a lower C/N ratio than a mixture of cow manure and rice straw. Based on the results of Coca-Cola sludge analysis, the C-organic content was very low, namely 0.49%, but the total N was very high, namely 1.27%, this factor greatly supports faster and more complete composting. According to the assessment of the quality of compost on SNI 19-7030-2004, compost is declared mature when the C/N ratio of compost is in the range of 10-20 (Ningrum, 2015).

The addition of Coca-Cola sludge to the compost had a very significant effect on the available P content. Treatment G, namely 2.5 kg GM + 1.5 kg DRS + 0.5 kg SC) gave the highest available P yield of 620.39 ppm and the lowest was found in treatment J (0.5 kg GM + 3.5 kg DRS + 0 kg SC) which is 363.75 ppm (Table 2). The high available P in the G treatment is thought to be closely related to the compost pH, namely 7.41, the closer to the neutral pH the better the activity of microorganisms so that the release of P in available form will be more and more. This is supported by the C/N ratio in the compost treatment which is also the lowest, namely 12.45 which proves the activity of microorganisms carrying out weathering.

The addition of Coca-cola sludge to the compost material also had a very significant effect on available K, the highest was obtained in treatment G (2.5 kg GM + 1.5 kg DRS + 0.5 kg SC) but not significantly different from treatments A, B, C, D, E, F and H and the lowest was in treatment J (0.5 kg GM + 3.5 kg DRS + 0 kg SC) namely 514.80 ppm. The increase in available K levels in treatment G was not only due to the addition of Coca-Cola sludge but also due to the contribution of better quality goat manure (Anon, 2011).

The addition of Coca-Cola sludge to the compost material had a very significant effect on the pH of the compost. Based on the research results, the average compost pH range is in the neutral pH range of 7.34 in treatment G and slightly alkaline 7.68 in treatment F. Optimal compost pH in

treatment G (2.5 kg GM + 1.5 kg DRS + 0 .5 kg SC) is suspected of adding Coca-Cola sludge which has a neutral pH of 6.91 with the amount of administration not too high. The composting process occurs optimally in the range of pH 6.5-7.5 (Supraptiningsih and Sarengat, 2014).

The addition of Coca-cola sludge had a very significant effect on the compost DHL, the highest was found in treatment I (1.5 kg GM + 2.5 DRS + 1.5 SC) = 10.99 mmhos/cm (high) and the lowest in treatment D (1.5 CM +2.5 DRS + 1.5 SC) = 4.26 mmhos/cm (moderate). The DHL value of compost is classified as moderate to high, presumably due to the high salt content dissolved in the basic ingredients. The results of the initial analysis of Coca-Cola sludge were classified as high, namely 13.56 mmhos/cm.

The addition of Coca-Cola sludge to the compost material had no significant effect on the moisture content of the compost, the average compost moisture content was 18.25% - 29.63%. According to Ningrum (2015) states that if the water content of the compost is too high it will result in a denser material, because it can damage the microbial food source and block incoming oxygen. Indonesian National Standard 19-7030-2004 stipulates that the maximum moisture content of compost is 50%, therefore all compost produced has appropriate moisture content.

CONCLUSION

Based on the results of this study it can be concluded that the addition of Coca-Cola sludge treatment had a significant effect on the addition of compost material. The addition of 0.5 kg of Coca-Cola sludge to 2.5 kg of goat manure mixed with 1.5 kg of rice straw in treatment G showed the best compost results as indicated by the highest N, P, and K parameter values, C/N lowest ratio, as well as neutral compost pH. Based on the results of this study it can be suggested that it is necessary to carry out pot and field trials of the compost produced on several plants in several types of soil..

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