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Effervescent Organic Fertilizer: Evaluating Fermented Fruit Juice Tablets for Improved Vegetable Yields

Deo Aries T. Cutamora, Ph.D. [1]
1 – San Pascual National Agricultural High School

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Abstract

Organic farming is an agricultural practice that produces healthier food, such as vegetables, that holistically improves human and environmental preservation. However, using organic inputs such as fertilizer can be complicated for farmers because it requires much time, consumes space when storing, is challenging to transport, and requires more labor because it is heavier and bulkier. Recognizing these challenges, the researcher sought a more convenient solution by developing a new form of organic fertilizer: an effervescent tablet made from fermented fruit juice (FFJ) fertilizer. The process involved drying 15mL of FFJ until it caramelized. The caramelized FFJ was then added to the mixture of a base, which is the baking soda ($NaHCO_3$), and an acid, which is the cream of tartar (KC4H5O6). This mixture was developed into tablets using granulation and molding. The researcher secured three experimental setups of pechay and chili seedlings to test their effectiveness. Two groups were treated with either effervescent FFJ tablets or liquid FFJ, while one group was left untreated as a control. After one month, the plant's height, weight, number of leaves, and flowers were measured. The results showed that the effervescent FFJ and liquid FFJ produced nearly the same results regarding plant growth and number of flowers. Statistical analysis revealed no significant difference between the plants treated with effervescent FFJ and those treated with liquid FFJ regarding height, number of flowers, and number of leaves. Effervescent tablet FFJ also shows nearer neutral pH than the liquid FFJ. These findings suggest that the development of effervescent tablet fertilizer shows promise for improving plant growth while also addressing some of the inherent challenges of organic farming.

Keywords: Organic Farming, Effervescent Fertilizer, Fermented Fruit Juice, Plant Growth Enhancement, Sustainable Agriculture

I. Introduction

Organic farming is a method of agricultural production that focuses on growing vegetables without synthetic pesticides, fertilizers, or genetically modified organisms (GMOs). This approach emphasizes sustainability, environmental preservation, and healthier food production. Farmers and individuals are increasingly adopting organic farming, particularly as concerns about the environmental and health impacts of conventional farming continue to grow (Reganold & Wachter, 2016).

The effects of organic farming have been widely discussed. Research suggests that organic farming promotes healthier soil, reduces water pollution, and enhances biodiversity (Rodriguez & Kim, 2020). Additionally, the absence of harmful chemicals in organic farming is believed to result in more nutritious vegetables and a healthier environment. However, some critics argue that organic farming faces challenges such as lower crop yields and higher production costs compared to conventional methods (Jones, 2019). This can make it difficult for farmers, especially small-scale ones, to meet market demand or compete with larger commercial operations.

Another challenge in organic farming is that it tends to incur higher transportation and production costs. This is because organic materials are heavier and bulkier than synthetic fertilizers, often requiring additional labor in handling and distribution (Tröster, 2023). Moreover, organic fertilizer production can be complicated because it requires much time and is messy compared to synthetic alternatives (Ersek, 2021), leading to an inconsistency in nutrient levels in the fertilizer (Cherlinka, 2024). As a result, using organic fertilizers over a large farm can be impractical because of logistical demands, limited availability of resources, and time consumption (Babajani et al., 2023).

Recognizing these challenges faced by farmers when using organic inputs such as fertilizer, the researcher sought to create a more convenient solution by developing an effervescent tablet-form organic fertilizer from fermented fruit juice.

Research Objective

This study aims to develop an effervescent tablet fertilizer from fermented fruit juice and assess its effectiveness in pechay and chili.

The specific objectives of the study are as follows:

1. Compare the effects of effervescent FFJ and liquid FFJ on the height, weight, and number of leaves of pechay.
2. Compare the effects of effervescent FFJ and liquid FFJ on the height, number of flowers and number of leaves of chili.
3. Compare the pH of effervescent FFJ.
4. Determine if there is a significant difference between the effects of effervescent FFJ and liquid FFJ on the height, weight and number of leaves of pechay.
5. Determine if there is a significant difference between the effects of effervescent FFJ and liquid FFJ on the height, number of flowers, and number of leaves in chili.

II. METHODOLOGY

Collection of Specimen

The specimens for this study were collected from specific locations to ensure consistency and reliability. The Technical Vocational Education Department at San Pascual National Agricultural High School (SPNAHS) provided 1 gallon of fermented fruit juice, 33 pechay seedlings, and 15 chili seedlings. Additionally, 50 grams of cream of tartar and 500 grams of baking soda were purchased from a local market. The experiment was conducted at SPNAHS.

Procedure

A. Preparation of Caramelized FFJ

To integrate FFJ into the effervescent tablet formation, 15 mL of FFJ was extracted using a syringe and placed in a flat container for sun drying over 1-2 days. This process reduced the liquid to about 5 grams of a caramelized, concentrated residue, which remained slightly wet but was suitable for further use. This drying step is crucial as excessive moisture can lead to premature effervescence during tablet formation.

B. Preparation of FFJ Effervescent Tablet

Once the FFJ was caramelized, it was ready to be mixed with the effervescent tablet ingredients. Using stoichiometric calculations, a ratio of 1:2.24 was determined for baking soda (base) and cream of tartar (acid).

$KHC_4H_4O_6$ + $NaHCO_3$ → $KNaC_4H_4O_6$ + H_2O + CO_2

Cream of tartar baking soda sodium potassium tartrate Water Carbon dioxide

1. Molar Masses:

Cream of tartar ($KHC_4H_4O_6$) = 188g/mol

Baking soda ($NaHCO_3$) = 84g/mol

2. Mole-to-Mole Ratio

The reaction occurs in a 1:1 molar ratio: 1 mole of $KHC_4H_4O_6$ reacts with 1 mole of $NaHCO_3$.

3. Mass Ratio:

$\underline{188\text{ g } KHC_4H_4O_6}$ ≈ 2.24 g

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84 g $NaHCO_3$

After computing the acid-base ratio the researcher prepares to make the effervescent tablet. 1. First, 10.125 grams of cream of tartar was mixed with the caramelized FFJ in a mortar and pestle, and this mixture was left to dry for about 10 minutes to prevent premature reaction. 2. After drying, 4.5 grams of baking soda was added and mixed thoroughly. The mixture was then dried again to reduce moisture further and prevent early effervescence. 3. Once dry, the mixture was sieved to create uniform granules. 4. The granules, weighing approximately 20 grams in total, were molded into four effervescent tablets.

Before applying the effervescent tablet to the experimental set-up, the researcher measures the acidity and basicity of both fertilizers. According to Campbell (2022), pH measures how basic or acidic a substance is, and it has a range of 0-14. A pH greater than 7 means the substance is basic. A pH less than 7 means the substance is acidic. When the pH is exactly 7, it indicates that the substance is neutral.

The researcher measured the pH of fermented FFJ by dissolving four effervescent tablets in 1 liter of water. At the same time, 15mL of liquid FFJ was diluted in 1 liter of water. After that, both solutions were measured by a pH meter.

C. Application of FFJ Effervescent Tablet

The experiment involved three setups: 1. Effervescent FFJ Group: Four effervescent tablets were dissolved in 1 liter of water. 2. Liquid FFJ Group: 15 mL of FFJ was mixed with 1 liter of water. 3. Control Group: Only water was applied, with no fertilizer. Fertilizers were applied to the plants biweekly (every Monday and Thursday) starting from September 9 up to October 7 of this year. The 33 pechay seedlings and 15 chili seedlings were divided into three groups: 11 pechay and 5 chilies for each of the groups. Data was collected weekly by measuring the height and number of leaves of both the pechay and chili plants. Additionally, the weight of the pechay and the number of flowers produced by the chili were recorded during the harvesting phase.

III. RESULTS AND DISCUSSIONS

This chapter presents the analysis and interpretation of the data gathered after the experiment.

Table 1. Comparison between the effect of effervescent FFJ and liquid FFJ on pechay's height, weight and number of leaves.

No. of Plant	Plant Height (cm)			Plant Weight (g)			Number of Leaves		
	Control	Tablet FFJ	Liquid FFJ	Control	Tablet FFJ	Liquid FFJ	Control	Tablet FFJ	Liquid FFJ
1	9.5	12.2	17	1.5	2.95	3.45	5	7	6
2	16.8	12.2	15.5	7.5	2.2	6.4	7	7	6
3	12	20.5	17.7	1.7	11.2	7.8	6	7	7
4	15.7	14.6	12	4.4	4.8	6.7	6	6	8
5	11.5	11.4	12.5	1.61	4.35	3.1	6	6	7
6	13.9	20.1	21.8	6.3	7.3	18.9	7	8	10
7	12	20.6	15.5	2.4	8.5	3.8	6	10	7
8	10.8	17	15.7	4.3	5	5.3	7	7	6
9	19	18	14.1	1.9	9.55	3.2	7	7	6
10	17.3	14.7	11.1	9.7	3.5	3.1	6	6	8
11	13	21.5	13.5	2.1	4.3	2.2	6	6	7
Ave.	**13.77**	**16.62**	**15.13**	**3.94**	**5.79**	**5.81**	**6.27**	**7**	**7.09**

The table above shows that the average height of pechay in the control group is 13.72 cm. This shows lower growth compared to the pechay treated with the effervescent tablet containing FFJ and liquid FFJ. Meanwhile, the plants treated with effervescent tablet FFJ showed an average height of 16.62 cm. This is slightly higher than the pechay treated with liquid FFJ, which has an average height of 15.13 cm.

In terms of the weight of pechay, the plants treated with liquid FFJ showed an average weight of 5.81 g, almost the same weight as the pechay treated with effervescent tablet FFJ.

Regarding the number of leaves, the table shows that both the tablet and liquid FFJ treatments resulted in a greater number of leaves compared to the control group. The plants treated with the tablet FFJ produced an average of 7 leaves, while those treated with liquid FFJ exhibited a slightly higher average of 7.09 leaves.

Table 2. Comparison between the effects of effervescent FFJ on chili's height, number of flowers, and number of leaves.

No. of Plant	Plant Height (cm)			Number of Flowers			Number of Leaves		
	Control	Tablet FFJ	Liquid FFJ	Control	Tablet FFJ	Liquid FFJ	Control	Tablet FFJ	Liquid FFJ
1.	200	285	285	12	10	13	10	26	30
2.	210	300	300	8	11	15	38	30	39
3.	155	450	320	11	20	19	18	47	38
4.	360	390	355	9	19	17	22	44	40
5.	230	374	345	11	18	16	38	40	34
Ave.	**231**	**359.8**	**321**	**10.2**	**15.6**	**16**	**25.2**	**37.4**	**36.2**

The data in the table show the plant height, number of flowers, and number of leaves produced by chili plants under three different treatments. For plant height, the chili plants treated with effervescent tablet FFJ had the highest average of 359.8 cm, compared to those treated with liquid FFJ, which had an average height of 321 cm.

However, the results differ when considering the number of flowers. The plants treated with liquid FFJ produced a slightly higher average number of flowers (16) compared to those treated with effervescent tablet FFJ (15.6).

Regarding the number of leaves, the control group had an average of 25.2 leaves. In contrast, chili plants treated with effervescent tablet FFJ and liquid FFJ showed increased averages of 37.4 and 36.2 leaves, respectively, indicating a notable improvement in leaf production compared to the control group.

Effervescent Tablet FFJ	Liquid FFJ

6.83	5.43

Table 3. Comparison of pH between effervescent FFJ and liquid FFJ.

Table 3 presents the pH of the two solutions. The pH of effervescent tablet FFJ is pH 6.83, which is slightly acidic but closer to the neutral pH of 7 compared to the pH of liquid FFJ, which is pH 5.43. The pH of effervescent tablet FFJ is slightly higher or near neutral because the effervescent reaction or the reaction between the acid (cream of tartar) and base (baking soda) likely buffers the solution, making it less acidic than liquid FFJ.

	Category	Comp. t	Sig. level	Result	Decision
Height	Effervescent FFJ Liquid FFJ	1.020	0.320	Not Significant	Accept the null hypothesis
Weight	Effervescent FFJ Liquid FFJ	-0.016	0.987	Not Significant	Accept the null hypothesis
No. of Leaves	Effervescent FFJ Liquid FFJ	-0.117	0.861	Not Significant	Accept the null hypothesis

Table 4. Significant difference between the effects of effervescent FFJ and liquid FFJ on the height, weight, and number of leaves of pechay.

The table presents the results of a t-test comparing the effects of effervescent FFJ and liquid FFJ on the height, weight, and number of leaves in pechay. The computed p-value for plant height is 0.320, which is greater than the significance level of 0.05. As a result, the null hypothesis is accepted, indicating no significant difference in the effect of the two treatments on pechay height.

For plant weight, the computed p-value is 0.087, also higher than 0.05, showing no significant difference between the effects of effervescent FFJ and liquid FFJ on pechay weight.

A similar analysis was performed for the number of leaves, where the t-test result shows a p-value of 0.861, again greater than 0.05. This indicates that there is no significant difference between the effects of the two treatments on the number of leaves in pechay.

Table 5. Significant difference between the effects of effervescent FFJ and liquid FFJ on the height and number of flowers in chili plants.

	Category	Comp. t	Sig. level	Result	Decision
Height	Effervescent FFJ Liquid FFJ	1.173	0.275	Not Significant	Accept the null hypothesis
No. of Flower	Effervescent FFJ Liquid FFJ	-0.171	0.868	Not Significant	Accept the null hypothesis
No. of Leaves	Effervescent FFJ Liquid FFJ	0.270	0.794	Not Significant	Accept the null hypothesis

Table 5 shows that the computed p-value for the height of chili plants is 0.275, which is greater than the significance level of 0.05. This indicates that the difference in height between plants treated with the two fertilizers is not statistically significant.

Similarly, the t-test result for the number of flowers suggests that there is no significant difference in the number of flowers produced by plants treated with effervescent FFJ and liquid FFJ.

Lastly, the analysis of the number of leaves shows a computed p-value of 0.794, which is also greater than 0.05. This suggests that the effects of effervescent FFJ and liquid FFJ on the number of leaves produced by chili plants are not significantly different.

Conclusion

Based on the study's results, the effervescent tablet FFJ has a positive impact on plant growth, similar to the liquid FFJ. The effervescent tablet FFJ resulted in slightly higher average plant heights, with 16.62 cm for pechay and 359.8 cm for chili, compared to the liquid FFJ, which had average heights of 15.13 cm for pechay and 321 cm for chili. However, the weight of pechay was nearly the same for both fertilizers, indicating that both effervescent tablet FFJ and liquid FFJ effectively support weight gain in the plants.

Regarding the number of leaves in plants treated with both effervescent FFJ and liquid FFJ, it appears that both fertilizers produce similar effects, as the average number of leaves in both treatments is nearly the same.

For the number of chili flowers, liquid FFJ produced slightly more flowers (16 ave.) than the effervescent tablet FFJ, which also produced an average of 15.6 flowers in the chili plant.

The t-test of height and number of flowers and number of leaves shows no statistically significant difference between the plants treated with effervescent FFJ and those treated with liquid FFJ. Therefore, the two treatments likely have similar effects on plant growth.

Lastly, the effervescent tablet FFJ had the nearest pH (6.83) to neutral pH, which is 7, compared to the liquid FFJ, which had a pH of 5.43.

Therefore, the development of effervescent tablet fertilizer shows promise for improving plant growth while also addressing some of the inherent challenges of organic farming.

References

Babajani, A., Muehlberger, S., Feuerbacher, A., & Wieck, C. (2023). Drivers and challenges of large-scale conversion policies to organic and agro-chemical free agriculture in South Asia. International Journal of Agricultural Sustainability, 21(1). https://doi.org/10.1080/14735903.2023.2262372

Cherlinka, V. (2024). Organic Fertilizers And Their Benefits For Crops. eos.com/blog/organic-fertilizers/

Department of Agriculture. (2011). Production Guide of Fermented Fruit Juice. Retrieved from https://noap.da.gov.ph/wp-content/uploads/2022/05/Production-Guide-on-Fermented-Fruit-Juice.pdf

Ersek, K. (2021). 8 Advantages and Disadvantages of Using Organic Fertilizer. Retrieved from https://www.holganix.com/blog/8-advantages-and-disadvantages-of-using-organic-fertilizer

Jeremy and Marie. (n.d.). How to make effervescent drink tablets. Retrieved from https://jeremyandmarie.com/HUb/how-to-make-effervescent-drink-tablets

Jones, M. (2019). Challenges and opportunities in organic vegetable farming: A review. Vegetable Science, 51(1), 1-10.

NationalGeographic.org. (n.d.). Food. Retrieved from https://education.nationalgeographic.org/resource/food/

Omar, N., Zohir, N., Zaman, N., Abdul Aziz, A., & Kasim, N. (2023). Effectiveness of fermented fruit juice application on flowering and yield of Solanum melongena. International Journal of Innovation and Industrial Revolution, 5, 80-90. https://doi.org/10.35631/IJIREV.513008

Patel, S. G., & Siddaiah, M. (2018). Formulation and evaluation of effervescent tablets: A review. https://doi.org/10.22270/jddt.v8i6.2021

Professor Tushar. (2023). Preparation of effervescent granules. Retrieved from https://www.youtube.com/watch?v=zYGdcq3u8jM

Reganold, J. P., & Wachter, J. M. (2016). Organic agriculture in the twenty-first century. *Nature Plants, 2*(2), 1-8. https://doi.org/10.1038/nplants.2015.221

Rodriguez, A., & Kim, J. (2020). The impact of organic farming on soil health and environmental sustainability. Sustainability, 12(17), 7012. https://doi.org/10.3390/su12177012.

Shapiro, R. (2023). Making an effervescent tablet?. Retrieved from https://www.nutritionaloutlook.com/view/making-an-effervescent-tablet

Sulok, K. M. T., Osumanu, H. A., Choy, Y. K., Zehnder, J. A. M., Jalloh, M. B., Musah, A. A., & Abdu, A. (2021). Chemical and biological characteristics of organic amendments produced from selected agro-wastes with potential for sustaining soil health: A laboratory assessment. Sustainability, 13(9), 4919. https://doi.org/10.3390/su13094919

Tagotong, B. M. & Corpuz, S. C. (2015). Bio-organic fertilizer on pechay homegarden in cotabato. American Journal of Agriculture and Forestry 3(6-1), 6-9.

The Homestead. (n.d.). Fermented fruit juice (1000 ml). Retrieved October 4, 2024, from https://www.thehomestead.ph/product/fermented-fruit-juice-1000-ml/#:~:text=Instructions%3A%20(1)Get%201L,once%20or%20twice%20a%20week.

Tröster, M.F. (2023). Assessing the Value of Organic Fertilizers from the Perspective of EU Farmers Agriculture 13, no. 5: 1057. https://doi.org/10.3390/agriculture13051057

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... & Murray, C. J. L. (2019). Food in the Anthropocene: The EAT-Lancet Commission on healthy diets from sustainable food systems. The Lancet, 393(10170), 447-492. https://doi.org/10.1016/S0140-6736(18)31788-4