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Nutritional assessment of compost by SMC method for white button mushroom cultivation in Maharashtra

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Abstract

Like human beings and animals, White Button Mushroom (WBM) also require food, for growth and development of its fruit body. This fruit body is composed of certain chemical elements frequently referred to as plant nutrients or plant diet elements. Carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, boron, zinc and copper. Mushroom cultivated on the compost. Compost prepared for WBM was formulated without any addition of inorganic fertilizer. Samples were collected and dispatched to a research laboratory for analysis to determine the nutrient content of compost. The fresh compost had varied, with carbon: nitrogen ratio of 26.13 to 20.24% and carbon:phosphorus ratio of 49.95 to 34.92% and carbon:potassium ratio of 62.83 to 82.84%. Organic matter content between 31.65 to 24.49% and carbon between 39.79 to 17.81%. For the primary macronutrients, average total nitrogen content 1.25%, phosphorus measured 0.68%, and potassium was 0.414%. Boron 9.51 ppm, Mn 145.70 ppm, Fe 3515.58 ppm, Cu 10.17 ppm and Zn 25.53 ppm. Overall, fresh prepared compost is suitable for WBM cultivation.

Keywords: *Compost, Nutrients, C:N, C:P, C:K ratio, Agricultural wastes, White Button Mushroom (WBM).*

1. Introduction

Composting is that the natural breakdown of natural organic components with the assistance of utilization of microorganisms into solid natural matter (Hog Producers Sustainable Farming Group, 1996). The composted material has the preferences of improving soil structure, expanding natural matter, destroying plant pathogens and upgrading plant development (Fourti *et al.*, 2011). It is the most sensible, easy and inexpensive away to do away with and recycle agriculture waste which helps in improving and hold the surroundings (Fares *et al.*, 2011).

However, insufficient amount or negative biodegradability of intrinsic microbial community used can also without difficulty result in low composting effectiveness and undesirable compost (Xi *et al.*, 2012). Production

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of the White Button Mushroom (WBM) in the world 8758MT and in India on accounts that 2006 to 2018 (FAO, 2019). The main additives in mushroom developing substrate from farms in India and global are generally agriculture waste merchandize and different materials, which encompass hay, straw, horse bedding, poultry litter, corn cobs, corn stover, cotton seed meal, cocoa hulls and gypsum in diverse amounts and quantities (Chang and Miles,1989; and Stamets, 2000). The added substances are mixed and blended well, placed inside a production facility, and pasteurized with steam warm to sterilize the substrate before inoculation to spawn (Wuest, 1982).

During developing stage of mushroom, sphagnum peat moss is added afterward (Beyer, 2003; and Chang and Hayes, 1978). The limited information is available regarding the composition of compost for *Agaricus bisporus* cultivation. The main aim of this research was to examine the compost for elements properties considered important for the WBM cultivation. Numerous researchers reported that the composting degradation ranging from 52-60 ^{0}C, whereas others recommended that lower temperatures might be more appropriate for composting, (Campbell, 1997). Nutrients are playing very vital role since it ensures that the process will be completed effectively from the microbiological point of view. To release the maximum nutrients temperature should be around 55-60 ^{0}C to eliminate pathogens that are harmful to humans and plants (Waszkielis *et al*., 2013).

The overall aim of the study is to understand the nutrients release in composting process at different period and during cultivation of WBM cultivation and observation in fruit body. Agricultural wastes contribute to a substantial volume of waste produced in India which making it a likely researcher for investigations on nutritional amendments in compost for WBM cultivation. It will also contribute to reduce the accumulated wastes in the India and environmental pollution. As such consecutive experimental trials were carried out to achieve the objective of the study and to provide precise and effective parameters for actual compost for WBM cultivation. The parameters to be investigated in this experiment are macro and micro nutrients, moisture content and temperature. Accordingly, the research questions of this trial experiment are as follows:

1. To find a practical solution for the agriculture waste with spent mushroom compost (SMC) method composting instead of burning?
2. To find out the variation of nutrients profile of compost material during composting and cultivation of WBM Cultivation?

2. Materials and methods

The study was conducted at Wiekfield Mushroom Composting Yard Facility farm, Pune, Maharashtra. The compost was prepared by SMC method using the following ingredients:

Table 1: Compost composition

Ingredients	Qty (kg)	Carbon %	Total Carbon	Nitrogen %	Total Nitrogen	C:N Ratio	P %	C:P Ratio	K %	Total K	C:K Ratio
Wheat straw	14450	48.5	7008.25	0.532	76.87	91.17	0.46	105.43	0.62	89.59	78.22581
Soya bean straw	7920	45.92	3636.864	0.86	68.11	53.40	0.079	581.27	1.55	122.76	29.62581
Sugarcane leaves	6160	45.5	2802.8	1.4	86.24	32.50	0.67	67.91	0.219	13.4904	207.7626
Poultry manure	14350	18.925	2715.738	3.3	473.55	5.73	1.97	9.61	0.138	19.803	137.1377
Gypsum	3575		0		0.00	0.00				0	
Total	46455	158.85	16163.65	6.092	704.78	—	3.179	——	2.527	1173.918	——
Average		39.71	3232.730	1.52	140.955	26.13	0.795	49.95	0.632	49.129	62.83
SD±		12.056	2250.357	1.072	169.053	—	0.711	—	0.561	48.171	——

Note: Total N% = Total kg of N / Total Qt of MaterialsX100 (704.78 / 46455)X100=1.517Say 1.52.

For preparation of compost, the composting yard was cleaned with formalin @2% solution 24 h before starting the composting process. After collection of ingredients was mixed properly and made into rectangular pile measuring 100 (length)' × 40 (width) × 5' (height).The heap was turned inside out and remade on the 2nd day from zero day to maintain aerobic fermentation of the substrate and also to remove excess ammonia trapped in the pile due to microbial activity. The pile was again turned inside out and remade on day 4th, 6th. The pile was turned for three times during composting process by mechanized machine turner known as bob cat. The capacity of bobcat turner five tons per hour. After 3rd turning compost were kept additional for two days. Thereafter 8th day the half rotten compost were transferred in tunnel for pasteurization. The compost was pasteurized in three stages:

1. **Pre Heat Stage (PRHS):** Tunnel entryway and window were closed for 36-48 h with ventilation framework. The temperature was accomplished by self-generation of warmness by the compost without steam infusion. Temperature was maintained between 48-50 ^{0}C. This handle was completed on 10th day of composting.
2. **Peak Heat Stage (PHS):** During peak heat stage the compost temperature were maintained 57 ^{0}C ± 1 for 6-8 h by injecting the steam in order to ensure effective pasteurization. Fresh air was introduced by opening of ventilators. This process was completed on 11th day of composting.
3. **Post Heat Stage (POHS):** Temperature of compost was maintained between 45-65.2 ^{0}C for 3-5 days, till the period of ammonia were narrow down. By introducing of fresh air cooled down the temperature of compost was 20.8-24 ± 1 ^{0}C.This process was completed on 18th day of composting. To humanize the agriculture waste material, primary moisture content was adjusted by addition essential quantity of water. Mixing different kinds of organic materials provided well-drained and arable compost pile. In the compost more variation of the materials, the better chance of maintain the nutrients and efficient decomposition. Table 1 shows the different mix ratio. The samples were acquired as the material was being removed from a various stages of composting stages. Each sample was placed in a 5 kg capacity of plastic bag and taken to Doctors Analytical Laboratory for analysis. Research facility tests measured the following properties: Carbon, Nitrogen (N), Phosphate (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Manganese (Mn), Iron (Fe), Copper (Cu), and Zinc(Zn). AOAC 20th Edition 2016 explanatory strategies utilized for each test were obtained at Doctors Analytical Laboratories (Latimer, 2016).

3. Statistical analysis

The results were analyzed using SPSS software package and ANOVA using one way analysis of variance. The nutrients content were assessed in the compost during compositing and WBM cultivation. Differences in mean, standard deviation, coefficient of determination (Polynomial) R^2 and graph. Variables more closely related among each other.

4. Results and discussion

The analysis of results of the compost for WBM cultivation shown in Table 2 as follows:

Table 2: The analysis results C:N, C:P and C:K ratio in white button mushroom compost

S. No.	Factors	Unit	Day-0	Day-2	Day-4	Day-6	Day-18	Day-28	Day-39	Day-49	Average	SD±
1.	C	g/100	39.71	36.5	34.41	32.61	25.5	23.53	19.85	17.81	28.74	7.61
2.	N	g/100	1.52	1.5	1.47	1.42	1.2	1.09	0.95	0.88	1.25375	0.24
3.	**C:N**	**Ratio**	**26.13**	**24.33**	**23.41**	**22.96**	**21.25**	**21.59**	**20.89**	**20.24**	—	—
4.	C	g/100	39.71	36.5	34.41	32.61	25.5	23.53	19.85	17.81	28.74	7.61
5.	P	g/100	0.795	0.78	0.76	0.75	0.73	0.59	0.55	0.51	0.68	0.11
6.	**C:P**	**Ratio**	**49.95**	**46.79**	**45.28**	**43.48**	**34.93**	**39.88**	**36.09**	**34.92**	—-	—
7.	C	g/100	39.71	36.5	34.41	32.61	25.5	23.53	19.85	17.81	28.74	7.61
8.	K	g/100	0.632	0.63	0.489	0.452	0.315	0.328	0.254	0.215	0.41425	0.15
9.	**C:K**	**Ratio**	**62.83**	**57.94**	**70.37**	**72.15**	**80.95**	**71.74**	**78.15**	**82.84**	—	—

4.1. C:N ratio

Based on substratum formulations C:N ratio of mixed ingredients was 26.13 on zero days. There was a significant distinction in chemical and nutritional composition properties among substrate formula utilized in this study (Tables 1 and 2). The total C-value of this parameter was the most elevated in substrate formula 48.5% in wheat straw and the lowest 18.925% in poultry manure. C and N substance in substrate compost decreasing slowly the day of composting increased (Table 2). During the study, C:N ratio of compost significantly varied between 26.13 to 20.24.

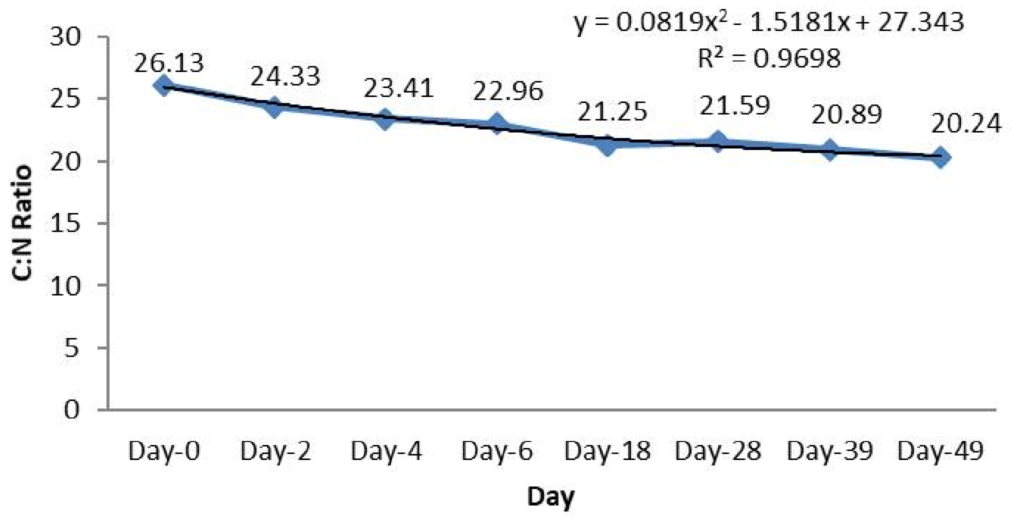

Figure 1: C:N ratio variation during WBM (*A. bisporus*) composting and cultivation

The C:N profile of compost were generated during composting and cultivation of WBM showing highly significant relationship between composting degradation and C:N ratio. The polynomial equation and R^2 = 0.9698 considered as reasonable and significant compost ingredients which can be suitable for WBM cultivation.

Organic matter decomposition and stabilization of the compost can be measured by analyzing the changes in C / N ratio of the compost (Kalamdhad *et al*., 2009). In the present study, C / N ratio was reduced from 26.13 to 20.24 respectively. However, combination of agriculture ingredients plays a major role in proper degradation with regard to C / N ratio. The C: N ratio plays the most important part and for good compost. Pace *et al*. (1995) reported that the organic material consists of 20-30 parts of carbon and one part of nitrogen is good for composting. To guarantee a good composting process, the starting mixture has to an adequate C:N ratio between 25-35 (Alsanius *et al*., 2016).

Normally C:N proportion of 45-50 essential to be combined with a substrate with a high N content such as food waste or poultry manure in order to produce a palatable compost (Streminska and Raviv, 2016). Microorganism normally utilize 30 portions by weight of carbon for each portion of nitrogen, a C:N ratio would seem most necessary for efficient composting (Hwangbo and Jo, 2014). The C:N content between 26-40 as recommended by many researchers, provide for rapid and effective composting (Gaur and Mathur, 1990). Results showed that C:N proportion obtained from compost is suitable for WBM cultivation.

4.2. C:P ratio

The C:P ratio of WBM compost in this study shown in Table 2**.** Fresh mushroom compost C:P ratio varied between 36.15 to 70.66 (Fidanza *et al*., 2010). The phosphate concentration is important for a series of functions in the fruit body metabolism and is one of the essential nutrients required for growth and development P-deficient exhibit retarded growth and often a dark color (Yawalkar *et al*., 2016). Results showed that C:P ratio obtained from compost varied between 34.92 to 49.95 and suitable for WBM cultivation (Figure 2). The C:P profile of compost were generated during composting and cultivation of WBM showing significant relationship between composting degradation and C:P ratio. The polynomial equation and R^2 = 0.8712 considered as reasonable and significant compost ingredients.

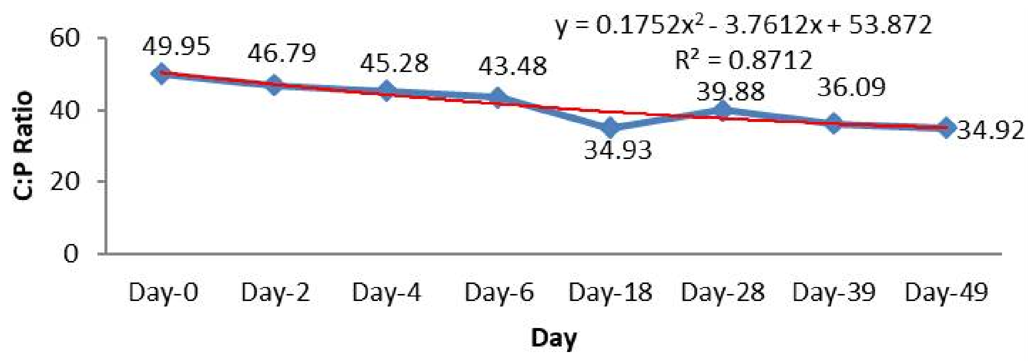

Figure 2: C:P ratio variation during WBM (*A. bisporus*) composting and cultivation

4.3. C:K ratio

The C:K proportion of WBM compost in this study presented in the Table 2. In fresh mushroom compost C:K ratio varied between 12.12 to 17.37 (Fidanza, 2010). It benefits in the development of proteins. The harmful impacts of additional nitrogen in compost Therefore a balanced ratio of N and K is essential in mushroom compost (Yawalkar *et al*., 2016). The present results showed that important ratio obtained compare to pervious literature described . The C:K profile of compost were generated during composting and cultivation of WBM showing significant relationship between composting degradation and C:K ratio. The polynomial equation and R^2 = 0.7538 considered as reasonable and significant compost ingredients (Figure 3).

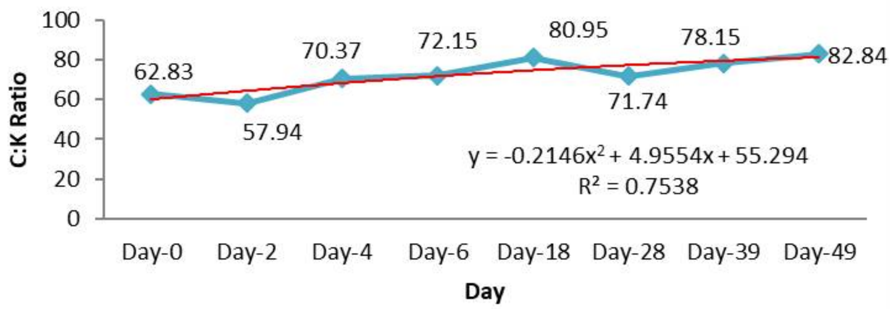

Figure 3: C:K ratio variation during WBM (*A. bisporus*) composting and cultivation

4.4. Organic matter and carbon

Organic matter content in compost varied between 31.65 to 24.49 and carbon 39.71 to 17.81. The organic matter and carbon in compost consist of decomposed agriculture and animal is often recommended for use in soil fertility (Rupert, 1995) .Organic matter and carbon is essential for enhancement of agriculture production

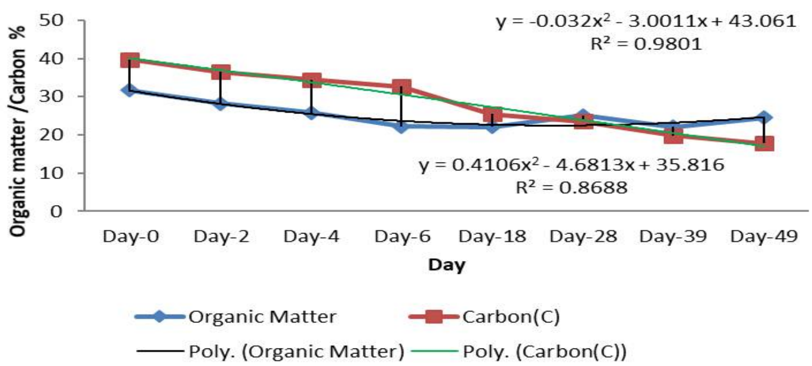

Figure 4: Organic matter and carbon variation trend during WBM (*A. bisporus*) composting and cultivation

(Davis *et al*., 2006; Lemaire *et al*., 1985; Lohr *et al*., 1984a; Rinker, 2002; Wang *et al*., 1984; and Wuest *et al*., 1995).The R^2 value of carbon is 0.9801 and organic matter 0.8688.The polynomial functions were generated from data obtained during composting and cultivation of WBM, considered as highly significant (Figure 4).

Table 3: Variation trend of macronutrients during composting and WBM cultivation

Macronutrients	Units	Day-0	Day-2	Day-4	Day-6	Day-18	Day-28	Day-39	Day-49	Average	SD±
1.Nitrogen (N)	g/100	1.52	1.5	1.47	1.42	1.2	1.09	0.95	0.88	1.25	0.24
2.Phosphorus (P)	g/100	0.795	0.78	0.76	0.75	0.73	0.59	0.55	0.51	0.68	0.11
3.Potassium (K)	ppm	6310	6300	4890	4520	3150	3280	2540	2150	4142.5	1513.32
4.Sulfur (S)	ppm	95.98	4409	5141	1133	9412	7481	6898	2910	4685	3003.54
5.Calcium (Ca)	ppm	225.2	13620	13620	13470	30530	14500	7982	7972	12739.9	8090.55
6.Magnesium (Mg)	ppm	42.74	2144	1943	1858	1840	1943	1596	1568	1616.84	620.41

4.5. Macronutrients

The average nitrogen content during the composting and cultivation was 1.25 ± 0.24 % (Table 1). In general, composts have 1-3% range (Acquaah, 2009). Average P content was 0.68 ± 0.11, K-4142.5 ± 1513.32 ppm, S-4685 ± 3003.54 (Table 3). On average, WBM compost contains the secondary macronutrients Ca 12739.9 ± 8090.55 ppm and Mg -1616.84 ± 41 ppm.The R^2 value of 0.9691 is high of nitrogen compare to phosphorus 0.9485. This values showed that better polynomial relationship during composting and cultivation of WBM (Figure 5).

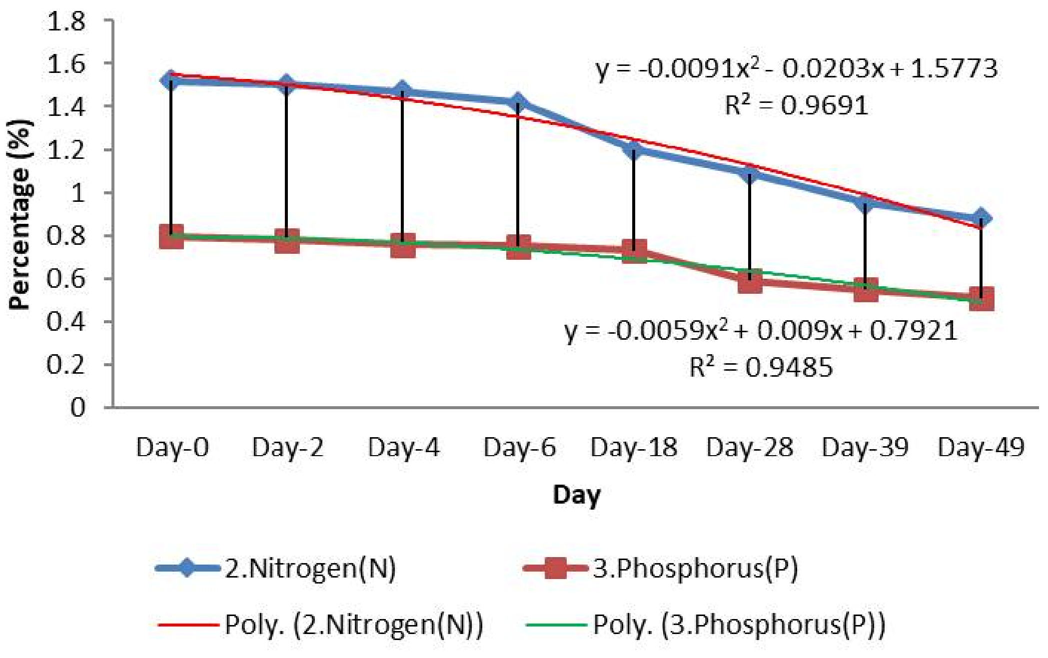

Figure 5: Nitrogen and phosphorous variation trend during WBM (*A. bisporus*) composting and cultivation

4.6. Micronutrients

The micronutrients Bo, Mn, Fe, Cu and Zn were detected in compost during composting and cultivation period of WBM (Table 4).

Table 4: Micronutrients variation trend during composting and WBM cultivation

	Day-0	Day-2	Day-4	Day-6	Day-18	Day-28	Day-39	Day-49	Average	SD±
1. Boron (Bo) ppm	0.05	0.05	0.05	0.05	41.51	18.82	15.51	0.05	9.51	14.12
2. Maganese (Mn) ppm	234	123.5	112.9	159.3	150.2	142	130.8	112.9	145.70	36.88
3. Iron (Fe) ppm	51.61	2841	2675	2532	5120	5010	4950	4945	3515.58	1696.92
4. Copper (Cu) ppm	11.08	10.08	7.43	7.33	7.3	16.22	11.7	10.2	10.17	2.82
5. Zinc (Zn) ppm	0.96	13.27	16.02	29.8	84.21	35.04	24.31	0.64	25.53	25.04

During the study average micronutrients sequence were found in compost like B < Cu < Zn < Mn < Fe. This order were arranged according to average content of micronutrients present in composting and cultivation of WBM. The micronutrients must be present for optimum growth for plant. This composition is particularly important for micronutrients which are required in small amounts (Yawalkar *et al*., 2016).

Table 5 Nutrients and R^2 Value of Compost during composting and cultivation of white button mushroom

Components	Maximum	Minimum	Average	SD±	R^2
C:N Ratio	26.13	20.24	23.185	2.945	0.9698
C:P Ratio	49.95	34.92	42.435	7.515	0.8712
C:K Ratio	82.84	62.83	72.835	10.005	0.7538
N:P Ratio	1.52	0.88	1.2	0.32	0.9691
Organic Matter	31.65	24.49	28.07	3.58	0.8688
Carbon	39.79	17.81	28.8	10.99	0.9801

5. Conclusion

The nutrients content variation in the compost during composting and WBM cultivation was measured for 49th days at various stages like turning, pasteurization, casing and cultivation. Polynomial functions were generated and considered as reasonable choice for compost. The C:N, C:P, C:K ratio and R^2 value was obtained, found significant (Table 5).

The C:N, C:P, C:K and N:P ratio is a pointer of compost stability. A reduced C:N ratio showed that at least decay and stabilization have occurred. N-P-K content set up the more than century ago. However, the compost that contains nutrients and natural matter is not subject to any precise principles for revealing its content, its quality or potential risks. There are no labeling standards and no published rule for the development of WBM compost to establish such rules, unless and only if such compost implies to be fertilizer.

The chemical composition of compost is directly related to mushroom development, and subsequently mushroom production. Because of the diversity in the composition of its ingredients, compost is chemically very complicated. The nutrients concentration of the compost in the present investigation is not revealed in the past literature. It was also be noticed that some inconsistency is possible because of the distinctive analytical system utilized in different studies on mushroom compost. The nutrients contained in the compost, be considered for WBM cultivation. The study indicated that locally accessible substrates can be utilized for compost preparation for WBM cultivation.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

References

Alsanius, B. W., Blok, C., Cuijpers, W. J., França, S. C., Fuchs, J. G., Janmaat, L. and van der Wurff, A. W. (2016). Handbook for composting and compost use in organic horticulture. *BioGreenhouse COST Action FA 1105*.

AOAC (2016). Official methods of analysis of AOAC International 20th edition Guidelines for collaborative study procedures to validate characteristics of a method of analysis. Gaithersburg, MD, USA.

Beyer, D. M. (2003). Basic procedures for Agaricus Mushroom. Publ. Distrib. Center, Pennsylvania State Univ.BioGreenhouse COST Action FA 1105.

Campbell Jr, A. G., Folk, R. L. and Tripepi, R. R. (1997). Wood ash as an amendment in municipal sludge and yard waste composting processes. *Compost Science & Utilization*. 5 (1), 62-73.

Chang, S.T. and Hayes. W.A. (1978). *The Biology and Cultivation of Edible Mushrooms.* Academic Press, New York.

Chang, S.T. and Miles. P.G. (1989). *Edible Mushrooms and Their Cultivation*. CRC Press, Boca Raton, FL.

Davis, D.D., Kuhns, L.J. and Harpster, T.L. (2006). Use of mushroom compost to suppress artillery fungi. *J. Environ. Hort.* 24, 212-215.

FAO (2019). https://agriexchange.apeda.gov.in/ProductSearch/Major_Exporing_Countries Uncomtrade Rome.

Fares, R., Fares, E. and De-Nardo, F. (2011). *Composting from A to Z*, Italian Agency for Development Cooperation, Beirut.

Fidanza, M. A., Sanford, D. L., Beyer, D. M. and Aurentz, D. J. (2010). Analysis of fresh mushroom compost. *HortTechnology*. 20 (2), 449-453.

Fourti, O., Jedidi, N. and Hassen, A. M. (2011). Comparison of methods for evaluating stability and maturity of co-composting of municipal solid wastes and sewage sludge in semi-arid pedo-climatic condition. Natural Science, 3 (2), 124-135.

Gaur, A. C. and Mathur, R. S. (1990). Organic Manures. In Soil Fertility and Fertilizer Use. IV. V Kumar el al., (Eds.) IFFCO, New Delhi, pp 140-159

Hog Producers Sustainable Farming Group (1996). Composting Factsheet Series, Pacific Agricultural Research Centre (Agassiz) Agriculture and Agri-food Canada; and *Resource Management Branch*, BCMA, 382.500-515.

Hwangbo, S. and Jo, I. H. (2014). Effects of mixing ratios of cow manure and composting bulking agent on physico-chemical characteristics and earthworm (eiseniafoetida) survival. *Journal of the Korea Organic Resource Recycling Association*. 22 (1), 57-66.

Kalamdhad, A. S., Singh, Y. K., Ali, M., Khwairakpam, M., and Kazmi, A. A. (2009). Rotary drum composting of vegetable waste and tree leaves. *Bioresource Technology*, 100(24), 6442- 6450.

Latimer Jr, G. W. (2016). Official methods of analysis of AOAC INTERNATIONAL 20th edition, Appendix D, Guidelines for collaborative study procedures to validate characteristics of a method of analysis. Gaithersburg, MD, USA.

Lemaire, F., Dartigues, A. and Riviere, L.M. (1985). Properties of substrate made with spent mushroom compost. *Acta Hort*. 172, 13-29.

Lohr, V.I., O'Brien, R.G. and Coffey, D.L. (1984a). Spent mushroom compost in soil lessm media and its effect on the yield and quality of transplants. *J. Amer. Soc. Hort. Sci.* 109, 693-697.

Pace, C. N., Vajdos, F., Fee, L., Grimsley, G. and Gray, T. (1995). How to measure and predict the molar absorption coefficient of a protein. *Protein Science*. 4 (11), 2411-2423.

Rinker, D.L. (2002). Handling and using "spent" mushroom substrate around the world. Mushroom Biology and Mushroom Products, UAEM, Cuernavaca.

Rupert, D. R. (1995). Use of spent mushroom substrate in stabilizing disturbed and commercial sites. *Compost Sci. Util*. 3, 80-83.

Stamets, P. (2000). The Himematsutake mushroom Agaricus blazei. In Growing gourmet and medicinal mushrooms (pp. 208-216). Ten Speed Press Berkeley, CA.

Streminska, M. A. and Raviv, M. (2016). 3 Microbiology of the composting process. *Handbook for Composting and Compost Use in Organic Horticulture*. 45.

Wang, S. H. L., Lohr, V.I. and Coffey, D.L. (1984). Spent mushroom compost as a soil amendment for vegetables. *J. Amer. Soc. Hort. Sci.* 109, 698-702.

Waszkielis, K. M., Wronowski, R., Chlebus, W., Bia³obrzewski, I., Dach, J., Pilarski, K. and Janczak, D. (2013). The effect of temperature, composition and phase of the composting process on the thermal conductivity of the substrate. *Ecological Engineering*. 61, 354-357.

Wuest, P.J. (1982). *Penn State Handbook for Commercial Mushroom Growers*. Pennsylvania State University Press, University Park, PA.

Wuest, P.J., Fahy, H. K. and Fahy, J. (1995). Use of spent mushroom substrate (SMS) for corn (maize) production and its effect on surface water quality. *Compost Sci. Util.* 3, 46--50.

Xi, B. D., He, X. S., Wei, Z. M., Jiang, Y. H., Li, M. X., Li, D. and Dang, Q. L. (2012). Effect of inoculation methods on the composting efficiency of municipal solid wastes. *Chemosphere*. 88 (6), 744-750.

Yawalkar, K. S., Agarwal, J. P. and Bokde, S. (2016). *Manures and Fertilizers*. Agri-Horticultural Pub. House.

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