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Research Article

The Effect of Nutrient Concentration on the Yield of Mushroom (*Pleurotus Osttreatus*)

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ABSTRACT

Various percentage concentration of wheat bran was used to examine their effect on yield of mushroom in terms of total and average yield. Wheat bran was added to saw dust the main substrate medium used for mushroom growth.
The treatment used are control, 2.5%, 5%, 7.5%, 10%, 12.5%, 15%, 17.5% and 20%. Six replicas of each treatment was made, sterilized and inoculated with spores of (Pleurotus ostreatus) mushroom. Data was collected over a 30 day period. Data obtained were analysed statistically using Duncan multiple range test (DMRT) at 5% level of probability. Results indicate a gradual increase in both total and average yield of mushroom from 2.5% to 12.5%. The highest growth yield (average) of 22.78g and total yield of 683.5g was observed for 12.5% wheat bran concentration. Also, after 12.5% of wheat bran concentration both average and total yield declined sharply due to contamination of the fruiting bags.
Consequently, higher nutrient concentration above 12.5% favoured the growth of competing organisms which cause spoilage. The study indicated that best results in terms of yield can be obtained by using wheat bran concentrations of 7.5% to 12.5%.

INTRODUCTION

In general, there are two broad classes of cultivated mushroom. Those that grow on compost and those that grow on woody material. The button mushroom and other *Agaricus* species grow on compost while Oyster mushroom *Pleurotus Ostreatus* prefer woody materials such as saw dust wood chips or sometimes straw.

There has been an increasing need to grow more mushrooms in terms of availability and quantitatively. Apart from consumption, mushroom serves useful purposes in industrial and pharmaceutical sectors of the economy. Mushroom has been grown basically, in the wild over the years. It is necessary to know the type of nutrient that will provide the highest yield considering the scarcity of mushroom in the market.

The main substrate material sometimes cannot provide the nitrogen required for optional growth of mushrooms. There is the need to provide supplements to enhance growth. (Oei 2003, Choi, 2004).

Beyer and Wilkinson (2002) found a direct correlation between substrate ammonia content and growth of mushroom.

Agro waste like sawdust contain lignin and cellulose which many Basidiomycetes like Pleurotus species are capable of degrading with the aid of carbohydrate and polyphenol oxidases (enzymes). However there has been a progressive decline in the quantity of ligin in saw dust during the growth of pleurotus species (Musieba et al 2012). Onuoha et al, (2009) stated that sawdust constitute one of the best substrates supporting mycelia growth and fructification of fungi, as saw dust contains the needed cellulose for growth.

Spawn quality is one of the most important factors in the production of edible mushrooms. In nature, mushroom use spores for generative multiplication (Stanley and Awi-Waadi 2010). Ukoima et al (2009) mentioned that cultivation of Volvariella volvae mushroom (Basidiomycetes) a non timber forest product on farm wastes like palm fibre gave a higher yield than sawdust.

Mushrooms are saprophytes or decomposers of organic matter, thereby converting waste organic matter into food.

Most agricultural waste used in the cultivation of mushroom is resistant to degradation because they contain celluloses, hemicelluloses and lignin. Fungal mycelium excretes extensive enzyme complexes which can directly attack and degrade these components (Dike et al. 2011).

The cultivation of Oyster mushroom requires a suitable temperature in order to obtain maximum yield. A temperature range of 23^0c to 28^0c is needed with an optimum of 25^0c. However, when the fruiting commences, it will thrive well at a temperature range of 17-23^0c (Olamide, 2009).

Also, in mushroom cultivation, it is necessary to reduce the intensity of light during the period of mycelium growth in order to enable the inoculated substrate have full ramification (Kenneth Ausubel, 2001), Although adequate light is required at the time of fruit formation.

Amory et al, (1997) mentioned that humidity is essential in order to prevent the mycelia and fruiting bodies of the mushroom from drying out. It is important to water the floor in which the mushroom is grown at least 2-3 times daily to maintain its humidity.

Berkeley and Kuo (2005) reported that infection of mushroom by Trichoderma green mold may result in over 30% production losses, parasitic insects, bacteria and other fungi all pose risks to indoor mushroom. The Scarid fly or Phorid fly may hatch eggs in growing medium which further hatch into worms and damage during all growth stages.

Bacterial blotch caused by pseudomonas bacteria or patches of Trichoderma green mold also pose risk during fruiting stage (Krawczyk et al 1993). The uses of sanitizing agents are available to use against these infestations.

Mushroom is rich in fibre, protein, vitamin B and also helps to maintain a healthy metabolism (Norris, 2009). Mushroom contains substances which protect the body against free radicals (Paster 2004). The objective of the research is to improve the yield of mushroom through the use of wheat bran, by determining which concentration of wheat bran will give highest yield in terms of fresh weight.

MATERIALS AND METHODS

The following materials were used in the conduct of the research. 5kg of sun dried saw dust was weighed into various transparent polythene sacks and various percentage concentration of wheat bran was added. The percentage concentration of wheat bran used was as follows: 2.5%, 5%, 7.5%, 10%, 12.5%, 15%, 17.5%, 20% and the control which had no wheat bran. Six (6) replica of each concentration were made including control. The wheat bran was mixed thoroughly with the saw dust in order to have an even distribution and 2gm of lime powder was added to each bag and mixed thoroughly. Oyster mushroom used in the Research was obtained from the teaching and Research farm as university of Port Harcourt, Nigeria, and spawn production done through the process of tissue culture.

All the samples were sterilized for 4 hours to destroy microbial contamination. The samples were then allowed to cool and inoculated with spawn of mushroom. Thereafter they were transferred to the incubation room and kept for about 30 days for ramification to occur.

The whole samples were then transferred to the fruiting room, where they were watered daily and data taken on the yield. Data obtained were subjected to analysis of variance using Duncan multiple range test at 5% level of probability.

RESULTS

Results obtained indicate a gradual increase in average and total yield of mushroom as the nutrient

concentration increases. At 12.5% nutrient concentration (wheat bran) the highest yield of 22.78g for average and 683.5g for total yield was obtained. Although there are other factors other than nutrient concentration that contribute to yield.

There was no significant difference in the yield of mushroom both in average and total yield between 5 to 10% nutrient concentration. Within this concentration range for wheat bran, nutrient did not have a significant effect mushroom yield.

However there was a sharp decline in yield of mushroom after 12.5% nutrient concentration. At higher nutrient concentration (15%, 17.5%, 20%), there are increased chances for other fungi to compete with the mushroom spore for available nutrient thereby creating a suitable environment for contamination to occur.

Although the control which contains no nutrient produced a total yield of 161g and an average yield of 5.37g, increase in yield can be obtained by nutrient addition and at the right proportion.

DISCUSSION

The study indicated that best results in terms of yield can be obtained in the cultivation of Oyster mushroom by adding supplements in the substrates to enhance yield (fresh weight). Wheat bran concentrations of 7.5% to 12.5% gave higher yield when compared to the control (saw dust). 12.5% of wheat bran when added to the saw dust substrate gave the highest total yield by 683.5g of harvested mushroom. The results obtained agree with findings that some supplements when added to substrates improved yield (Kadiri and Fasidi 1993, Ukoima et al 2009). Therefore, substrate composition and structure is important for vegetative fruiting bodies development.

CONCLUSION

Wheat bran has a vital role to play in increasing mushroom yield. In order to increase yield in Mushroom production; 12.5% of wheat bran concentration when added to saw dust substrate gives over 400% yields. Therefore mushroom production can be enhanced by adding 12.5% of wheat bran as nutrients.

RESULT

Table1: Effect of nutrient concentration (wheat bran) on Total and Average Yield of Mushroom.

Treatment (%)	Total yield (gm)	Average yield/month gm
Control	161	5.37
2.5	266	8.87
5	466	15.53
7.5	477	15.90
10.0	500	16.66
12.5	683.5	22.78
15.0	331	11.03
17.5	177	5.90
20.0	95	3.16

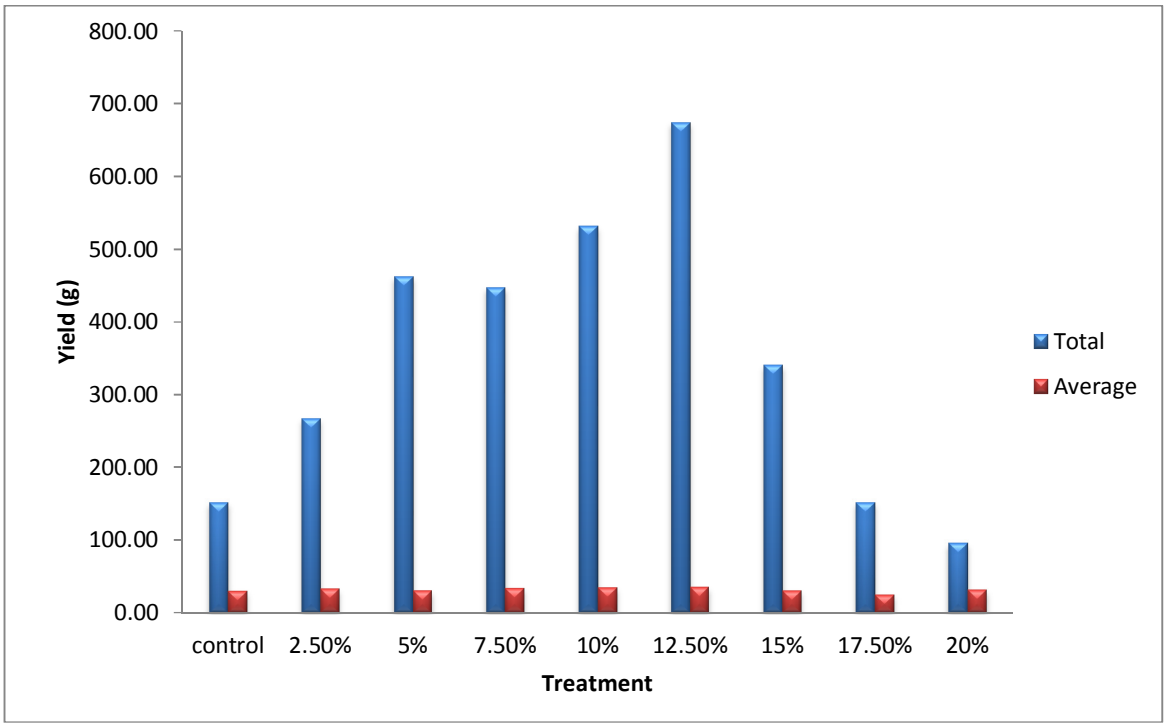

Fig 1: Total and average yield of mushroom due to varying concentration

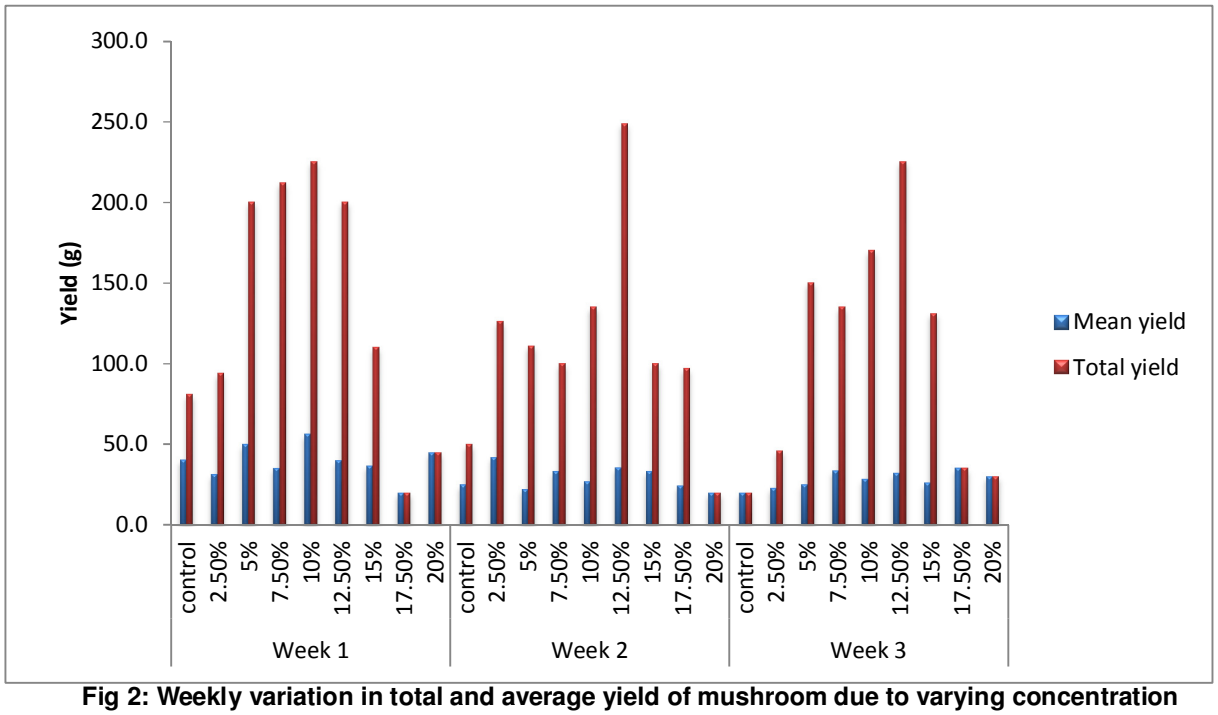

Fig 2: Weekly variation in total and average yield of mushroom due to varying concentration

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APPENDIX

One way ANOVA on the effect of treatment on mushroom yield

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Mean yield	Control	3	28.500	10.6888	6.1712	1.948	55.052	20.0	40.5
	2.5%	3	32.111	9.5238	5.4986	8.453	55.770	23.0	42.0
	5%	3	32.400	15.3062	8.8370	-5.623	70.423	22.2	50.0
	7.5%	3	34.139	1.0552	.6092	31.518	36.760	33.3	35.3
	10%	3	37.194	16.5161	9.5355	-3.834	78.223	27.0	56.3
	12.5	3	35.881	3.9424	2.2761	26.087	45.674	32.1	40.0
	15%	3	32.067	5.3471	3.0871	18.784	45.350	26.2	36.7
	17.5%	3	26.417	7.7312	4.4636	7.211	45.622	20.0	35.0
	20%	3	31.667	12.5831	7.2648	.409	62.925	20.0	45.0
	Total	27	32.264	9.2400	1.7782	28.609	35.919	20.0	56.3
Total yield	Control	3	50.33	30.501	17.610	-25.44	126.10	20	81
	2.5%	3	88.67	40.266	23.247	-11.36	188.69	46	126
	5%	3	153.67	44.613	25.757	42.84	264.49	111	200
	7.5%	3	149.00	57.297	33.081	6.67	291.33	100	212
	10%	3	176.67	45.369	26.194	63.96	289.37	135	225
	12.5	3	224.50	24.254	14.003	164.25	284.75	200	249
	15%	3	113.67	15.822	9.135	74.36	152.97	100	131
	17.5%	3	50.67	40.821	23.568	-50.74	152.07	20	97
	20%	3	31.67	12.583	7.265	.41	62.92	20	45
	Total	27	115.43	70.247	13.519	87.64	143.21	20	249

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Mean yield	Between Groups	269.110	8	33.639	.310	.952
	Within Groups	1950.730	18	108.374		
	Total	2219.840	26			
Total yield	Between Groups	103208.2	8	12901.023	9.254	.000
	Within Groups	25093.167	18	1394.065		
	Total	128301.4	26			

Post Hoc Tests

Homogeneous Subsets

Mean yield

Duncan[a]

Treatment	N	Subset for alpha = .05
		1
17.5%	3	26.417
Control	3	28.500
20%	3	31.667
15%	3	32.067
2.5%	3	32.111
5%	3	32.400
7.5%	3	34.139
12.5	3	35.881
10%	3	37.194
Sig.		.281

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Total yield

Duncan[a]

Treatment	N	Subset for alpha = .05				
		1	2	3	4	5
20%	3	31.67				
Control	3	50.33	50.33			
17.5%	3	50.67	50.67			
2.5%	3	88.67	88.67	88.67		
15%	3		113.67	113.67	113.67	
7.5%	3			149.00	149.00	
5%	3			153.67	153.67	
10%	3				176.67	176.67
12.5	3					224.50
Sig.		.102	.071	.064	.072	.134

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Oneway ANOVA on the effect of week on mushroom yield

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Mean yield	Week 1	9	39.454	10.5749	3.5250	31.325	47.582	20.0	56.3
	Week 2	9	29.180	7.2312	2.4104	23.621	34.738	20.0	42.0
	Week 3	9	28.158	5.0541	1.6847	24.274	32.043	20.0	35.0
	Total	27	32.264	9.2400	1.7782	28.609	35.919	20.0	56.3
Total yield	Week 1	9	131.89	78.214	26.071	71.77	192.01	20	225
	Week 2	9	109.72	63.376	21.125	61.01	158.44	20	249
	Week 3	9	104.67	73.702	24.567	48.01	161.32	20	225
	Total	27	115.43	70.247	13.519	87.64	143.21	20	249

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Mean yield	Between Groups	702.545	2	351.273	5.556	.010
	Within Groups	1517.295	24	63.221		
	Total	2219.840	26			
Total yield	Between Groups	3773.907	2	1886.954	.364	.699
	Within Groups	124527.4	24	5188.644		
	Total	128301.4	26			

Post Hoc Tests

Homogeneous Subsets

Mean yield

Duncan[a]

Week	N	Subset for alpha = .05	
		1	2
Week 3	9	28.158	
Week 2	9	29.180	
Week 1	9		39.454
Sig.		.788	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 9.000.

Total yield

Duncan[a]

Week	N	Subset for alpha = .05
		1
Week 3	9	104.67
Week 2	9	109.72
Week 1	9	131.89
Sig.		.457

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 9.000.