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The Effect of Sorbitol and Mannitol Supplementation at Casing on the Productive characteristics of Agaricus bisporus Mushroom

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Abstract
This study is aimed at investigating the effect of supplementing 1, 3 and 5% of Sorbitol and Mannitol at casing on the productive characteristics of the mushroom *Agaricus bisporus*. The results revealed a significant increase in the total production and biological efficiency of *Agaricus bisporus* mushroom .Treatment 1% Sorbitol mushroom recorded the highest production (1286, 90 g/bag) compared with 798.5 g/bag for the control group and 745 g/bag for the Mannitol 1% mushroom ($p<0.05$).Besides, the biological efficiency was increased from 53.23% to 85.79% with the same supplement. None of the Mannitol supplemented treatment surpassed that of the control group for both traits. However Mannitol 1% recorded significantly higher values when compared with other Mannitol treatments for the total yield and biological efficiency .Sorbitol and Mannitol1% treatments showed significantly the higher values for fruiting body number and the lowest fruit body weight (80, 40 and 16.25 and 17.74, numbers and grams, respectively). Most of the yield occurred on the first break. The full growth compost supplemented with 1% Sorbitol tended to have a more synchronous maturation for the second break in fewer days when mushrooms were harvested. Earliness (days from casing) for Sorbitol, Mannitol 1% treatments and the control group mushroom was reported to be 18 days which differ significantly as compared with all other treatments($p<0.05$).
Keywords: *Agaricus bisporus*, Sorbitol and Mannitol, Casing layer.

Introduction

The button mushroom [*Agaricus bisporus* (Lange) Singer] is the most widely cultivated and consumed mushroom throughout the world which includes about 40% of total world mushroom production (1). Production of the common cultivated mushroom is a multimillion-dollar industry in many countries (2). It has become a routine cultural practice to supplement the ready to spawn compost at spawning or at casing with different organic materials to increase the yield of the white button mushroom. These supplements, which are generally carbohydrate- or protein-rich, may carry or favor the growth of various weed molds and their application to the compost as such may infect the crop, leading to decreased yield or complete crop failure (3). Study of (4) found that supplementation at casing was better than at spawning. This is probably due to an extra nutrition provided by supplements at this stage, which is directly utilized by mushroom mycelia for increased yield. Supplementation at spawning is generally associated with a rise in temperature and incidence of weed molds, which may jeopardize the yield (5).

Earlier studies showed that the addition of various materials to the compost strongly enhanced yields of cultivated mushrooms. For example; (6, 7) reported that the supplementation of mushroom compost at spawning and at casing with small amounts of vegetable oils and nutrients resulted in increased yield. Furthermore, (8), reported that mushroom yields may also be stimulated by supplementation of first break mushroom compost with hydrolyzed protein, commercial supplements and crystalline amino acids. In a study (9) conducted to assay the Biological and quality characterizes efficacy of *A. bisporus* when supplementation with 1, 3 and 5% from each starch, sucrose and glucose, adding at casing period(10). They found that the treatment of 1% from starch, enhanced yields by 15.77% of cultivated mushrooms. The goal of this study was to instigating the effects of the Sorbitol and Mannitol Supplementation at casing on the yield and biological efficiency of *Agaricus bisporus* mushroom.

Materials and Methods

Compost preparation: Compost was prepared at Mushroom Farm Unit , College of Agriculture , Tikrit University from September 2015 to December 2015. The preparation of compost including two Phases (11).
Phase I composting: Phase I composting was initiated by mixing and wetting the ingredients (Wheat straw 1000 Kg, chicken manure 600 Kg, Wheat bran 25 Kg and Calcium Sulphate 30 Kg) as they were stacked in a rectangular pile with tight sides and a loose center. Normally, the bulk ingredients were put through a compost turner. Gypsum were spread over the top of the bulk ingredients and were thoroughly mixed by the Tractor and Hooper. By these two machines, the compost was placed on a tunnel with concrete floor called Bunker and aerated by the forced passage of air via nozzles. Turning and watering of compost were done at 3-day intervals, Phase I composting lasts from 9 days.
Phase II composting: There are two major purposes to Phase II composting. Pasteurization is necessary to kill

any insects, nematodes, pest fungi, or other pests that may be present in the compost. Second, it is necessary to condition the compost and remove the ammonia that formed during Phase I composting. The compost was placed in an insulated tunnel with a perforated floor and controlled aeration. The pasteurization period lasted for 7 days ,temperature arose to 58 ºC (by steam) in the second day , lowered to 55-47 in the next 4 days and to 25 ºC in the seventh day. The nitrogen content of the compost should be 2.0 to 2.4 percent, and the moisture content between 68 – 72% and pH 7.5.

Spawn Preparation: A mother culture of *A. bisporus* strain B62 that obtained from Mushroom Farm Unit at the Agriculture College, Tikrit University was used in this study. Spawn was prepared by sterilizing a mixture of wheat grain plus water and 2% of $CaCO_3$ and 4% $CaSO_4$. Once the sterilized grain received a bit of *A. bisporus* mycelium added to it and incubated at 25 ºC, the grain and mycelium were shaken 3 times at 4-day intervals over a period of 14-day active mycelial growth. Once the grain was colonized by the mycelium, the product is called spawn.

Spawning: spawn was mixed into the compost at the rate 3% and triple layer spawning. The plastic bags (60 x 40 cm) were poured by prepared compost at weight 5 kg followed by spawning method and incubated at 25 ºC and 90% relative humidity. The full growth compost was obtained.

Adding the Supplementation and Casing layer: After the completion of mycelium running, the supplements were added and covered with Casing layer composed from a mixture of peat moss with sand at a ratio of (1:1).A top-dressing was applied at 4cm on the top of full growth compost. The temperature was lowered Daily at 2 ºC to 16 ºC with ventilation for pinhead formation. After the development of pinhead, the data of yield attributing and yield were recorded.

Statistical Analysis: The statistical analysis of the data was performed using SPSS statistical software. Duncan's New Multiple Range Test was used for treatments means comparison at the 5% significant level.

Results and Discussion

Sorbitol and mannitol supplemented at 1, 3 and 5% levels after completion of mycelium running of *A. bisporus*, showed a significant increase for both, the total yield and biological efficiency as compared with the control treatment. The total yield and biological efficiency were significantly ($p<0.05$) higher 1286.90 and 85.79% at the 1% level of Sorbitol as compared with all other treatments. The lowest total yield and biological efficiency were observed at 5% Sorbitol level as compared with all other treatments. Likewise, similar trend was recorded regarding the percentage increase or decrease from that of control treatment values. The highest percentage increase (+32.56%) was recorded in the level 1% of Sorbitol treatment compared with all other treatments. The lowest percentage decrease (-53.23%) was observed at Sorbitol 5% level compared with all other treatments (Table 1).

Virtually all the supplement products developed for addition to compost at either spawning or casing have been based on high protein ingredients. Although several researchers have long assumed that the benefit of mushroom supplements is due to the nitrogen content of the protein, several lines of reasoning suggest that protein nitrogen is not an essential for the supplement effect. In fact, the mushroom yields using higher protein supplements are not consistently higher than those using low protein supplements. Alongside, these supplements supports the hypothesis that improved mushroom yields are associated with the addition of carbon instead of nitrogen. Potential ingredients are those containing cellulose, hemicellulose, gums and other polysaccharide-rich materials, although ingredients containing cellulose and hemicellulose are preferred because ingredients containing simple sugars or starch are subjected to attack by compost microorganisms and result in dangerously high compost temperatures. The increased yield obtained by using a supplement depends, among other factors, on the nitrogen contents of the compost. The supplementing effect seems to be at its best in poor or not excessively rich compost (4). The positive effect on compost with low nitrogen content may be due to an alteration of the C/N ratio to an optimal levels. The compost contains many minerals, which go into it with the straw, horse manure or broiler chicken manure. Most minerals will therefore be present in sufficient quantity in the compost, and they are very unlikely to be a limiting factor on the yield in any case. Since the mushroom absorbs much more organic than inorganic matter during growing, the compost will be richer in minerals at the end of growing than at the beginning. There are no indications found in the published literature that minerals are a limiting factor in a normal compost. Another possibility is that since growth may be stimulated by symbiosis with other microorganisms present in the compost, microflora growth may be enhanced by the addition of supplements to make available some of its products of decomposition for their growth (12).

Table 1. Effect of supplements sorbitol and mannitol on the yield and biological efficiency of *A. bisporus*.

Treatments (%)	1st break	2st break	3rd break	Total Yield (g/bag)[a]	Biological Efficiency (%)	% change from control
	(g/bag)					
Sorbitol 1	**974.2a**	**312.7a**	**0b**	**1286.9a**	**85.79**	**+32.56**
Sorbitol 3	**408.5d**	**89.0f**	**0b**	**497.5e**	**33.16**	**-20.07**
Sorbitol 5	**0e**	**0g**	**0b**	**0g**	**0**	**-53.23**
Mannitol 1	**551.5b**	**193.5c**	**0b**	**745.0c**	**49.66**	**-3.57**
Mannitol 3	**395.0d**	**145.0d**	**0b**	**540.0d**	**36.00**	**-17.23**
Mannitol 5	**133.5e**	**128.8e**	**0b**	**262.3f**	**17.48**	**-35.75**
Control	**503.5c**	**205.0b**	**90.00a**	**798.5b**	**53.23**	**0**

[a] Means followed by the same letter(s) within each column are not significantly different (Duncan's new multiple range test, $p<0.05$).
[b] Biological efficiency defined as ratio of fresh mushroom weight to dry compost weight expressed as a percentage.

The results presented in Table 2 revealed that the days from casing to the first harvest were found to be ranged from 18 to 22 days. The Sorbitol and Mannitol at 1% and Control group mushroom were the lowest for earliness values 18 days which differ significantly from all other treatments mushroom values. Mannitol 5% mushroom showed the highest value (22 days) . Appreciable significant variation were recorded regarding the number of body fruits at different levels of Sorbitol and mannitol. The number of fruit bodies was the highest (80) at 1% Sorbitol level . The lowest (0) was recorded at 5% at Sorbitol for all treatment. Increasing the number of fruit bodies in compost supplemented with 1% Sorbitol could be related to an increase of carbon in the compost, which might be resulted in an alteration of the C/N ratio to optimal levels. In case of average fruit bodies weight, the highest value 21.85 g recorded at 5% of mannitol. Besides, the lowest value (15.65 g) was recorded in the control treatment mushroom (Table 2).

Table 2. Effect of supplements sorbitol and mannitol on the yield attributes of *A. bisporus* mushroom .

Treatments	Earliness (Days from casing)[a]	Total number of fruiting body per bag[a]	Average fruit body weight (g)[a]
Sorbitol 1%	18c	80a	16.25cd
Sorbitol 3%	21ab	24e	20.73a
Sorbitol 5%	0d	0g	0e
Mannitol 1%	18c	42c	17.74bc
Mannitol 3%	20b	29d	18.62b
Mannitol 5%	22a	12f	21.85a
Control	18c	51b	15.65d

[a] Means followed by the same letter(s)within each column are not significantly different (Duncan's new multiple range test, ($p<0.05$).

References

Ahmed, J. J.; Hassan, A. A. and Thalij, K. M. (2015). Estimation the Effect of Carbon Supplementations Additive at Casing in the Productivity and Quality Characterizes of *Agaricus bisporus* Mushroom. Tikrit J. Agric.15 (2): 10-21.

Dahlberg, K.R. (2004). Carbohydrate-based mushroom supplements. Mushroom News 52:6–11.

Gerrits, J.P.G. (1986). Supplementation with formaldehyde treated soybean meal. Journal of Mushroom, 161, 169- 174.

Hassan , A. A. (2009). First Report of Diseases and Pests of an Edible Mushroom *Agaricus bisporus* in Iraq1.The Fungal Infections. Tikrit J. Agric. 13(4): 60-71.

Mami, Y.; Peyvast, G.; Ghasemnezhad, M. and Ziaie, F. (2013). Supplementation at casing to improve yield and quality of white Button mushroom. Agriculture Sciences. 4(1): 27-33.

Pardo-Gime´nez, A.; Zied, D. C.; Álvarez-Ortì, M.; Rubio, M. and Pardo J. E. (2012). Effect of supplementating compost with grapeseed Meal on Agaricus bisporus production. J. Sci. Food Agric. Society of Chemical Industry. J. Sci. Food Agric. 1-7.

Royse, D.J.,and Chalupa, W. (2009). Effects of spawn, supplement and phase II compost additions and time of re-casing second break compost on mushroom (*Agaricus bisporus*) yield and biological efficiency. Bioresource Technology 100 (2009) 5277–5282.

Royse, D.J.,and Sanchez, J.E. (2008). Supplementation of first break mushroom compost with hydrolyzed protein, commercial supplements and crystalline amino acids. World J Microbiol Biotechnol 24:319–

325.

Schisler, L.C. (1967). Stimulation of yield in the cultivated mushroom by vegetable oils. Appl. Microbiol. 15, 844-850.

Schisler, L.C. and Sinden, J. W. (1966). Nutrient supplementation of mushroom compost at casing-vegetable oil. Can. J. Botany. 44:1063-1069.

Vijay, B. and Gupta, Y. (1995). Production Technology of *Agaricus bisporus*. In: Advances in Horticulture Vol. 13 – Mushroom. Eds. Chadha KL and Sharma SR. Malhotra Publishing House, New Delhi- 110064, India.

Vijay, B.; Sharma, S. R. and Lakhanpal, T. N. (2002). Effect of treating Post- composting supplements with differents concentration of Formaldehyde on the yield of *Agaricus bisporus*. Proc. Int. Conf. ICMBMP Mushroom Biol. Mushroom Products. UAEM.ISBN 968-878-105-3.