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Research Article

EFFECT OF HEAVY METALS ON GROWTH OF MYCELIUM OF DIFFERENT STRAINS OF *Agaricus bisporus L.*

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ABSTRACT
Literature pertaining to uptake of heavy metal ions by cultivated mushroom (*Agaricus bisporus*) from substrate is scantly available. It is known that uptake of heavy metals by the test organism culminates in an altered pattern of growth and development of the inhabitant host plant. It was with this perspective that the present work was undertaken. During this study it was found that cadmium chloride and Mercuric chloride stimulates inhibition in growth of the strain 11 strain 3634, strain 1927 and stain 3607 of *A. bisporus*. The extent of inhibition as a result of treatment with Cadmium chloride has been greater in the strain S-3634 and S-3607. Inhibition has also been noticed in the strain S-1927 S-11.Mercuric chloride also inhibits growth the greatest effect being in this order S-11> S-3634 >S-3607 >S-1927**.**

Keywords: *Spore suspension in Normal Saline, Filter Paper Disc of Cadmium Chloride and Mercuric Chloride, Zone of Inhibition (cm)*

INRODUCTION
Heavy metals are required as trace elements by some organisms for their various metabolic processes, growth and sustenance. Any excess or deficiency of such elements may lead to severe physiological consequences. Indiscriminate use of pesticides and related compounds has resulted into accumulation of these pesticides as residual molecule. The degradation product of large number of pesticides has also resulted into accumulation of a large variety of heavy metals in the soil. Since soil is the main substrate for growth and development of a large array of mushrooms, this soil contaminant has also adversely affected the life of mushrooms (Kalac *et al.*, 1999; Ohe *et al.*, 1981; Jain *et al.*, 1988; Mitra, 1994; Purkayastha and Mitra, 1992; Yasui *et al.*, 1988; Das, 2005). During present study an attempt has been made to evaluate the effect of Cadmium chloride and Mercuric chloride on Strain11, Strain 3634, Strain 3607 and Strain 1927 of *Agaricus bisporus*.

MATERIALS AND METHODS
Test organism: The strain was obtained from Indian Agricultural Research Institute, New Delhi. Auxanographic studies with heavy metals are the pre-requisite condition to carry out such study. It was obtained from commercial source as Calcium chloride (Merck) and Mercuric chloride (Merck).

Method of Preparation of the Sample: A thick spore suspension of different strains (S-11, S-3634, S-3607, S-1927) was prepared from a slant. The spore suspension was mixed in molten agar media without agitation (Temperature 45°C).

Filter paper disc impregnated with different concentration (5 µg, 10µg, 20 µg and 50µg) of Mercuric chloride and cadmium chloride were placed at different marked places, filter paper disc without heavy metals served as control in each case. Each filter paper disc absorbed 0.005 ml of the solution and hence dilution was prepared to suit the respective requirements.

Filter paper disc of uniform diameter was prepared with the help of a punch and placed in pre sterilized normal saline vials. Suitable dilution of stock obtained from solution of Mercuric chloride and Cadmium chloride were prepared from sterile normal saline.

RESULTS AND DISCUSSION

Effect of Cadimium chloride and mercuric chloride on different strains of Agaricus bisporus.

Effect of Cadmium Chloride

Filter paper disc impregnated in the solution of cadmium chloride of different strength was placed at the top of the solidified agar media surface. Immediately after transfer using sterilized forceps, the plate was transferred to incubator the temperature of which was pre-fixed to 37^0C.The record of observation made after 96 hours of incubation has been described in Table 1.

Table 1: Effect of different concentration of Cadmium chloride on different strains of *Agaricus bisporus*

Concentration of cadmium chloride	STRAINS USED			
	S-11	**S-3634**	**S-3607**	**S-1927**
Control	0	0	0	0
05 µg	0	0	0	0
10 µg	0	0	0	0
20 µg	1.5	2.0	2.0	1.5
50 µg	1.93	3.0	3.0	2.0

Average value of three replicates in each case

On review of data described in Table-1 it appears that all the used strain viz S-11, S-634, S-3607 and S-1927 can resist a concentration of 5ug and10ug of Cadmium chloride. But a concentration beyond 10ug to the extent of 20ug causes varied degree of sensitivity and resistance to cadmium chloride. The strain S-11 and S-1927 generates a zone of inhibition to the extent of 1.5cm whereas; strain S-3634 and S-3607 yields a zone of inhibition of 2cm. A concentration of 50ug of cadmium chloride seems to have considerable extent of toxicity to all the strains. This concentration has been found to revoke a zone of inhibition to the extent of 3.0 cm in strain S-3634 and S-3607.The value has been 1.93 cm for the strain S-11 and 2cm for the strain S-1927. A vivid account of which has been depicted in Figure 1.

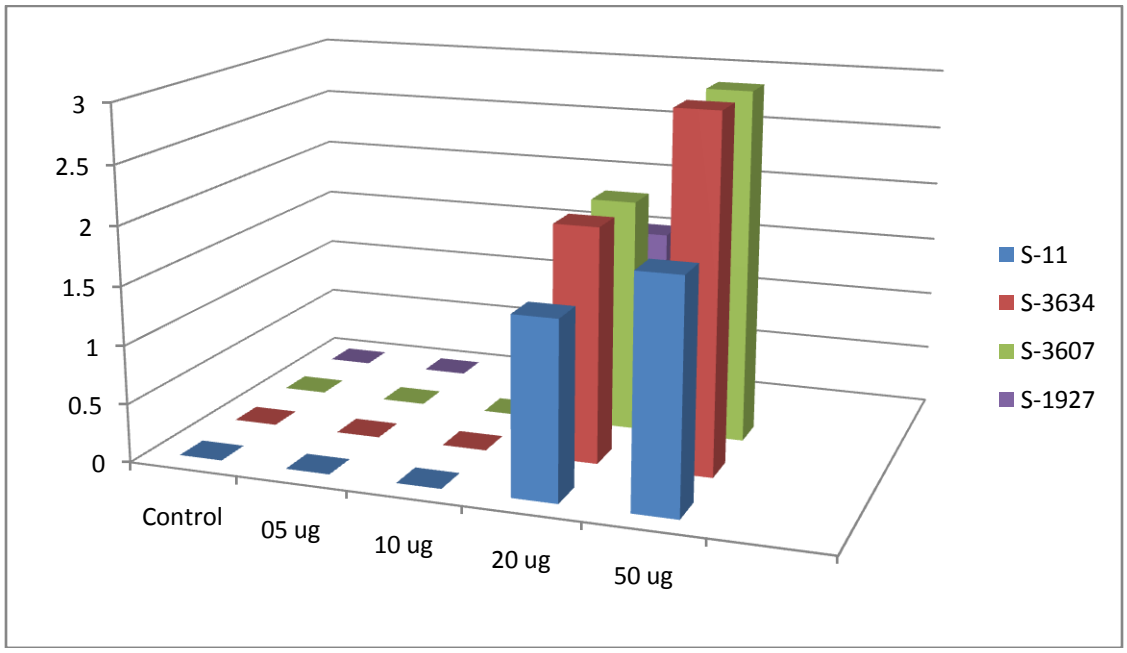

Figure 1: The extent of sensitivity and resistance to different concentration of Cadmium chloride in various strains of *Agaricus bisporus*

Effect of Mercuric Chloride

Following the above described protocol the effect of Mercuric chloride on different strains was also monitored.

Table 2: Effect of varied concentration of Mercuric chloride on strains of *Agaricus bisporus*

Concentration of cadmium chloride	STRAINS USED			
	S-11	**S-3634**	**S-3607**	**S-1927**
Control	0	0	0	0
05 µg	0	0	0	0
10 µg	0.9	0.75	0	0
20 µg	1.0	1.0	0.05	0.03
50 µg	1.5	1.0	1.0	0.85

Average value of three replicates in each case

On review of data described in Table 2, it appears that all the used strain *viz* S-11, S-3634, S-3607 and S-1927 can resist a concentration of 10 µg of Cadmium chloride. But a concentration beyond 10 ug to the extent of 20ug causes varied degree of sensitivity and resistant to cadmium chloride. The strain S-11 and S-1927 generates a zone of inhibition to the extent of 1.5 cm whereas; strain S-3634 and S-3607 yields a zone of inhibition of 2 cm. A concentration of 50ug of cadmium chloride seems to have the desired level of toxicity to all the strains. This concentration has been instrumental in generating zone of inhibition to the extent of 3.0 cm in strain S-3634 and S-3607.The value has been 1.93 cm for the strain S-11 and 2 cm for the strain S-1927. A vivid account of which has been depicted in Figure 2.

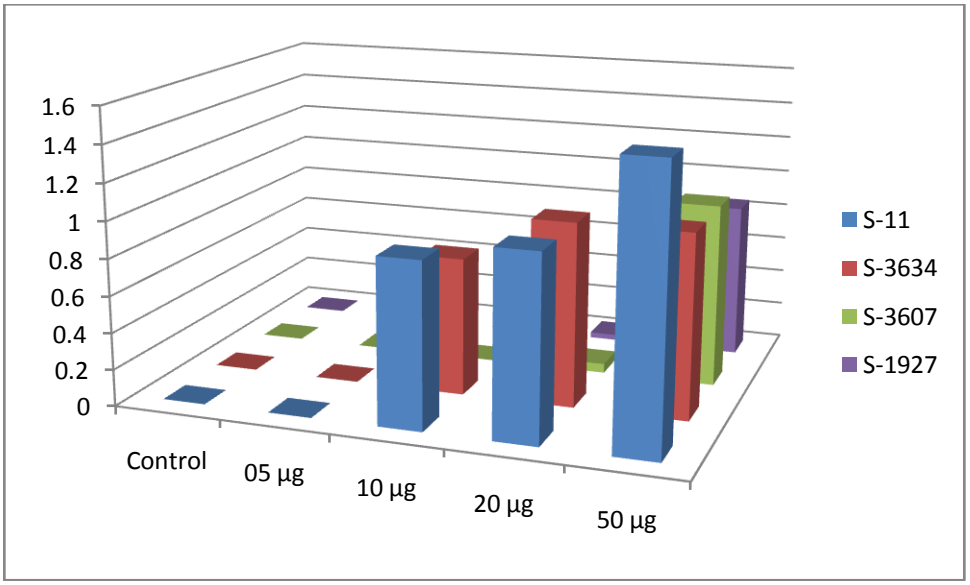

Figure 2: The extent of sensitivity and resistance to different concentration of Mercuric chloride in various strains of *Agaricus bisporus*

Uptake of heavy metals by different genus of mushroom has been reprted by various workers. This includes uptake of metals in *Volvariella volvacea* (Purkaystha and Mitra, 1992), Oyster mushrooms (Yasui *et al.*, 1998), *Pleurotus sajor caju* (Jain *et al*., 1998). The accumulation of Cd^{2+} in *Lycoperdon edodes* (Ohe and Jujizo, 1981), Mercury, Copper, Cadmium and Lead in fruiting bodies of edible mushroom (Kalac *et al*., 1996, 1999, 2014). Tuzen *et al*., (1998) reported the presence of the heavy metals in some cultivated and uncultivated mushroom. During present study all the four strains of *Agaricus*

bisporus shows resistance to considerable concentration of cadmium chloride (up to 10 ug), the degree of sensitivity at 20 and 50 however differs. The degree of sensitivity to Mercuric chloride (05 ug) in the strains has been less than cadmium chloride. Thus the finding is an indication of tolerance of the strains to heavy metals. This suggests either up take of the heavy metals by the described strains or constitutive resistance of the strain towards heavy metals Cadmium chloride and Mercuric chloride. Fruiting bodies of mushrooms may be considered ideal for the purpose of biosorption of heavy metals because their potentiality for heavy metal have already proved (Das, 2005). During present study influence of heavy metals on the development of mycelium (which forms the fruiting body) has been evaluated. This suggests the test organism can naturally stand low concentration of heavy metals but can be inhibited by high concentration. Further study to elucidate uptake is under way.

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