BIOCHEMICAL CHANGES INDUCED IN SPINACH BY THE DOMINATING FUNGI FROM VEGETABLE WASTES

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***ABSTRACT*- Fruits and vegetable have serious challenges to their existence and these may affect and get spoilage due to fungal and bacterial attack. These wastes create hazards to the environment. In the present study dominating fungi viz. *Alternaria alternata, Aspergillus niger, Aspergillus flavus, Aspergillus fumigatus, Curvularia lunata, Fusarium oxysporum, Penicillium notatum Rhizopus stolonifer* and *Trichoderma viride* were isolated from vegetable waste. Study was carried out biochemical changes like dry weight, ash and protein of fresh spinach inoculated with these dominating fungi at 20 and 30 days of incubation period using the methods recommended by Association of Official Analytical Chemist (AOAC). There was a significant decrease in dry weight, ash and protein at 30 days of incubation period due to testing fungi when compared to the uninoculated control. The maximum dry weight decreased by *Trichoderma viride* as compare to the other fungi whereas ash was significantly decreased by *Trichoderma viride* followed by *Rhizopus stolonifer*. On the other hand maximum reduction in protein were recorded by *Alternaria alternata* but on other hand protein was increased due to *Trichoderma viride, Rhizopus stolonifer* and *Aspergillus niger as* compare to uninoculated control. These fungi were responsible to make the biochemical changes in the vegetable wastes. This clearly indicates that these fungi might be developing ability to degrade waste and converted in to simple form**

***Keywords*: Spinach, Biochemical changes, fungi**

INTRODUCTION

Vegetables are important and have dietary nutritional qualities. Fresh vegetables at local market due many microbial contaminants and pathogens it become spoilage. About 30 % of the fruits and vegetables grown in India get wasted annually [14]. Among the vegetable Spinach (*Spinacea oleracea* L.) is an important vegetable. Many diseases on spinach have been reported as externally and internally due to contamination of fungi [5]**.** Naturally occurring food such as fruits and vegetables normally contain some micro-organism and may be contaminated with additional organism during handling practices in food supply chain storage condition, distribution. The occurrence of fungal spoilage of vegetables is also recognized as a source of potential health hazard to man and animals. [3] & [7]. Fungi produce hydrolytic enzymes and it degrades carbohydrates, protein, cellulose or other biochemical changes take place. Accounting for 80% of the cellulose breakdown in nature particularly forest ecosystem where fungi play a significant roles in vegetable waste decomposition [8] & [15]. Biodegradation will increasingly play a significant role in future waste management schemes. The potential of utility of these residues can extend to the

stage or complete recycling of energy in the ecosystem by efficient manner. Within the controlled microbial degradation the potentiality of getting biologically important compounds for recycling as fertilizers for soil fertility would be detected, **[9].** In the present investigation to find out the biochemical changes in spinach tested with ten dominating fungi at different incubation period.

MATERIAL AND METHODS

Freshly harvested healthy spinach vegetables were collected from the markets. The spinach were dried naturally in the laboratory condition. These spinach distributed in to eleven conical flask (100 gm per flask) and were incubated separately with 2 ml spore suspension of the ten test fungi and one flask without spore suspension was kept as control, the flask were incubated for 20 and 30 days at room temperature. After incubation period vegetables samples were collected in separate sterilized flasks and prepared fine powder. This powder was used for study of biochemical changes like dry weight, ash and protein by standard biochemical methods [1].

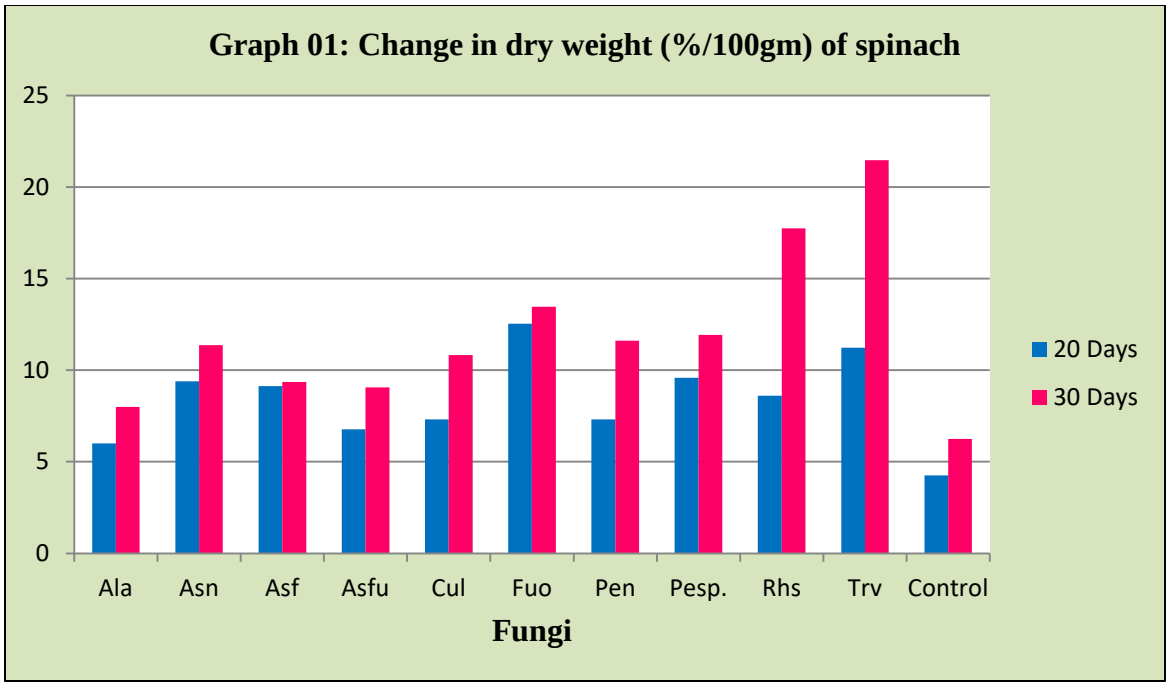
Statistical analysis

All the results were statistically analyzed using analysis of variance, means of the treatments were compared using the least significant difference (C.D., p = 0.05) which allowed determination of significance between different applications [10] & [11].

RESULT AND DISCUSSION

Table 1: Change in dry weight (%/100gm) of spinach

Fungi	Incubation period	
	20 Days	30 Days
Alternaria alternate	6.00	8.00
Aspergillus niger	9.40	11.36
Aspergillus flavus	9.13	9.36
Aspergillus fumigatus	6.78	9.06
Curvularia lunata	7.32	10.83
Fusarium oxysporum	12.53	13.46
Penicillium notatum	7.31	11.62
Penicillium sp.	9.58	11.92
Rhizopus stolanifer	8.61	17.74
Trichoderma viride	11.22	21.46
Control	4.25	6.25
S. E.	0.71	1.32
C. D. (p = 0.05)	1.58	2.94

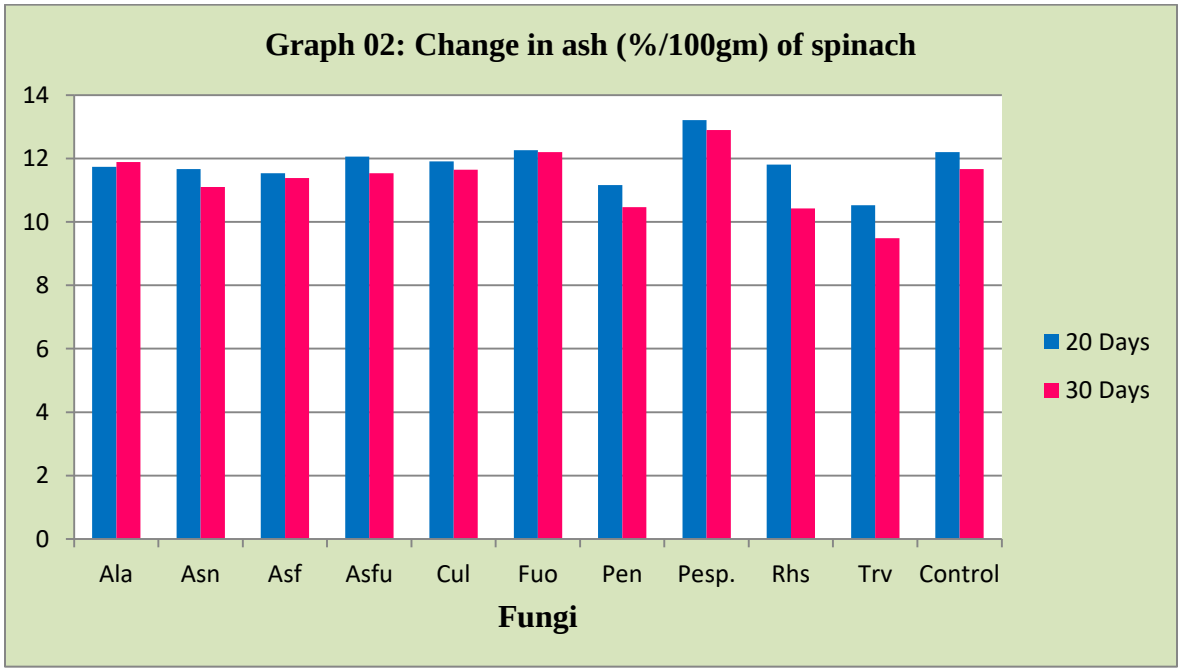


i) Change in dry weight (%/100gm) of spinach

From table No.1 and graph 01, it is clear that, *Trichoderma viride* was responsible for maximum decrease in dry weight of spinach at both incubation periods. It was also observed that in case of 20 days of incubation interval significant loss was recorded by *Fusarium oxysporum* followed by *Trichoderma viride, Penicillium sp., Aspergillus niger* and *Aspergillus flavus.* Lowest dry weight was recorded by *Alternaria alternata, Aspergillus fumigatus, Penicillium notatum, Curvularia lunata* and *Rhizopus stolonifer*. At on 30 days of incubation period dry weight was reduced by *Rhizopus stolonifer, Fusarium oxysporum, Penicillium sp., Penicillium notatum* and *Aspergillus niger* while *Alternaria alternata, Aspergillus fumigatus, Aspergillus flavus* minimum loss of dry weight were recorded as compare other tested fungi. The result showed that increase the weight loss by all tested fungi as compare to control, because fungi utilized the organic matter for their growth. Similarly work was done by [2] on biochemical changes in infected Dill (*Peucedonum graveolens*) with Mancozeb sensitive and resistant *Fusarium oxysporum*. [12], was also investigated biochemical changes induced by pathogenic fungi on *Hibiscus sabdariffa.*

Table 2: Change in ash (%/100gm) of spinach

Fungi	Incubation period	
	20 Days	30 Days
Alternaria alternata	11.73	11.89
Aspergillus niger	11.66	11.10
Aspergillus flavus	11.53	11.38
Aspergillus fumigatus	12.06	11.53
Curvularia lunata	11.91	11.64
Fusarium oxysporum	12.26	12.20
Penicillium notatum	11.16	10.46
Penicillium sp.	13.21	12.90
Rhizopus stolanifer	11.81	10.42
Trichoderma viride	10.52	9.48
Control	12.20	11.66
S. E.	0.20	0.28
C. D. (p = 0.05)	0.45	0.62

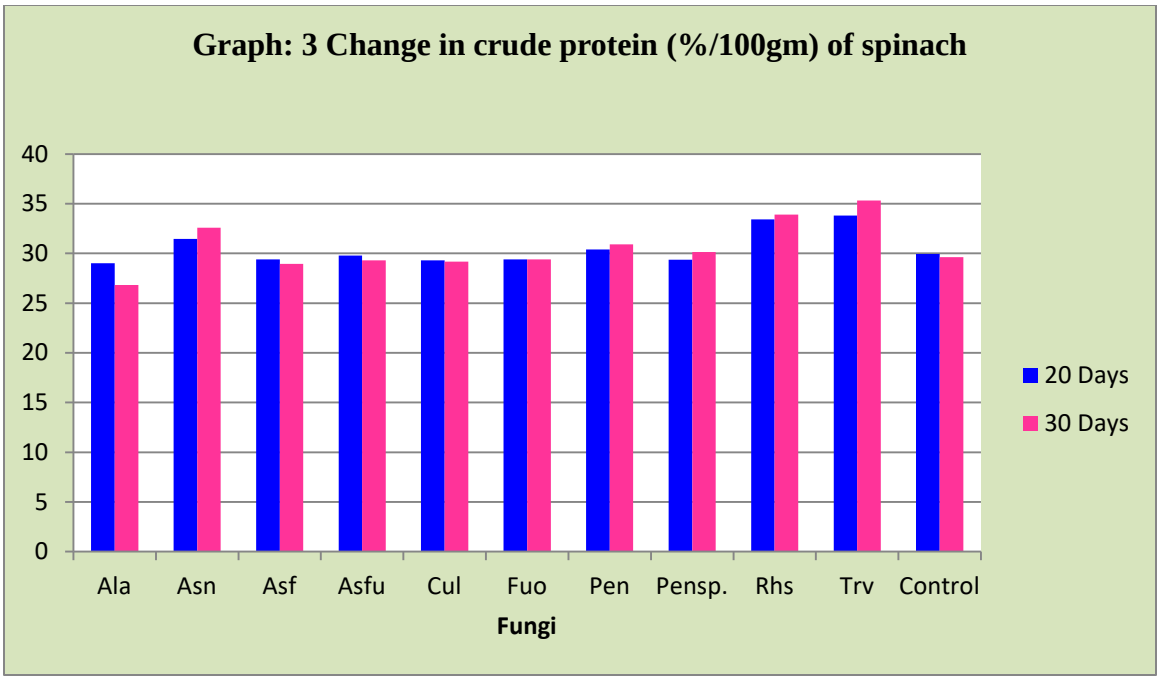


ii) Change in ash (%/100gm) of spinach

Ash of spinach was studied with the help of [1], method and results are summarized in table 02 and graph 02. It was clear from the result that, in case of 20 days of incubation period there was the significant decrease in ash by *Trichoderma viride, Rhizopus stolonifer* and *Penicillium notatum* while ash percentage also decrease in an average by *Aspergillus fumigatus* and *Aspergillus niger.* Minimum ash decreased due to *Aspergillus flavus, Aspergillus fumigatus* and *Curvularia lunata*. It was exciting that ash percentage of spinach was increased by *Penicillium sp.* and *Fusarium oxysporum*. On the other hand in case of 30 days of incubation period significant ash reduction by *Trichoderma viride, Penicillium notatum, Aspergillus flavus* and *Aspergillus niger*. Ash percentage was also reduced by *Alternaria alternata, Rhizopus stolonifer, Curvularia lunata* and *Aspergillus fumigatus* respectively. From the result it was clear that there is no maximum difference between two incubation periods. It was interesting that ash was increased by *Penicillium sp., Fusarium oxysporum* and *Alternaria alternata.* Supported work was done by [**13]** in that biochemical changes induced by the effect of fungi on *Dialium Guineense:* black velvet edible fruit. It was also similar study was made by [16]. Biochemical changes in Sapota Pulp (*Achras sapota* L.) due to Fungi,.

Table 3: Change in crude Protein (%/100gm) of spinach

Fungi	Incubation period	
	20 Days	30 Days
Alternaria alternata	29.00	26.83
Aspergillus niger	31.47	32.60
Aspergillus flavus	29.40	28.95
Aspergillus fumigatus	29.80	29.30
Curvularia lunata	29.29	29.16
Fusarium oxysporum	29.41	29.39
Penicillium notatum	30.39	30.90
Penicillium sp.	29.35	30.13
Rhizopus stolanifer	33.42	33.92
Trichoderma viride	33.80	35.33
Control	29.95	29.61
S. E.	0.51	0.74
C. D. (p = 0.05)	1.14	1.65



iii) Change in crude protein (%/100gm) of spinach

Protein is one of the important content of spinach it was estimated with the help of [1], method and results are summarized in table 03 and graph 03.

It was observed that significant decrease in protein by *Alternaria alternata, Curvularia lunata, Penicillium sp., Aspergillus flavus, Fusarium oxysporum* and *Aspergillus fumigatus* in 20 days of incubation period. On the other hand it was interesting to note that protein percentage increased by *Trichoderma viride, Rhizopus stolonifer, Aspergillus niger* and *Penicillium notatum* as compare to control. However in case of 30 days of incubation period maximum protein reduction were recorded by *Alternaria alternata* and *Aspergillus flavus*. Protein were also decreased by *Curvularia lunata, Aspergillus fumigatus* and *Fusarium oxysporum* respectively. On the other hand protein of spinach were gradually increased due to *Trichoderma viride, Rhizopus stolonifer, Aspergillus niger, Penicillium notatum* and *Penicillium sp.*. Similar work investigated by [6], on biochemical changes in spinach infected with carbendazim resistant *Alternaria spinaciae*. [4] was studied biochemical changes observed in host by benomyl resistance of *Fusarium oxysporum F. spinaceae* causing leaf spot of Spinach (*Spinaceae oleracea*).

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